Focus on Energy Calendar Year 2022 Evaluation Report

Volume III Appendices

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Appendix A. Key Achievements and Figures for State of Wisconsin and Focus on Energy

Offering Participants

- CY 2022 Residential: 220,427
  - Upstream Lighting and Income Qualified Participation: 741,409
- CY 2022 Nonresidential: 3,902
- CY 2022 Midstream: 1,649
- CY 2022 Total Participants: 225,978

Total Electric and Natural Gas Energy Usage

- CY 2021 Electric Sales to Wisconsin Retail Customers megawatt hours (MWh): 69,426,615[1]
- CY 2021 Wisconsin Aggregated Electric Utilities Noncoincident Peak Demand megawatts (MW): 16,428[2]
- CY 2022 Natural Gas Consumption (MThms): 4,325,400[3]

Total Verified Gross Annual Savings

- CY 2022 Energy Savings (MWh): 613,854
- CY 2022 Demand Reduction (MW): 83
- CY 2022 Natural Gas Savings (therms): 16,841,606

Total Verified Net Annual Savings

- CY 2022 Energy Savings (MWh): 410,556
- CY 2022 Demand Reduction (MW): 53
- CY 2022 Natural Gas Savings (therms): 12,869,872

Total Verified Gross Lifecycle Savings

- CY 2022 Energy Savings (MWh): 7,966,075
- CY 2022 Demand Reduction (MW): 83
- CY 2022 Natural Gas Savings (therms): 254,653,466

1 U.S. Energy Information Administration. Release Date: November 10, 2022. Independent Statistics and Analysis. "Wisconsin Electricity Profile 2021." https://www.eia.gov/electricity/state/Wisconsin/

2 Ibid.

3 U.S. Energy Information Administration. Independent Statistics and Analysis. Release Date: March 31, 2023. "Natural Gas Consumption by End Use." https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SWI_a.htm

Total Verified Net Lifecycle Savings

- CY 2022 Energy Savings (MWh): 5,622,149
- CY 2022 Demand Reduction (MW): 53

  CY 2022 Natural Gas Savings (therms): 188,603,893

Population Numbers

- CY 2020 Statewide Census Population: 5,893,718 [4]
- CY 2021 Wisconsin Residential Electric Accounts: 2,761,990[5]
- CY 2021 Wisconsin Nonresidential Electric Accounts: 361,589[6]
- CY 2021 Wisconsin Residential Gas Accounts: 1,823,385[7]
- CY 2021 Wisconsin Nonresidential Gas Accounts: 173,794[8]

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4 U.S. Census Bureau. Accessed April 2023. "Annual Population Estimates, Estimated Components of Resident Population Change, and Rates of the Components of Resident Population Change for the United States " https://www.census.gov/data/tables/time-series/demo/popest/2020s-state-total.html

5 U.S. Energy Information Administration. Release Date: October 6, 2022. "Annual electric power industry Report, Form EIA-861 detailed data files." Sales, revenue, and energy efficiency. https://www.eia.gov/electricity/data/eia861/

6 Ibid.

7 U.S. Energy Information Administration. Release Date: March 31, 2023. "Number of Natural Gas Consumers." https://www.eia.gov/dnav/ng/ng_cons_num_dcu_SWI_a.htm

8 Ibid.

Table A-1. CY 2022 Costs, Benefits, and Modified Total Resource Cost (mTRC) Test Results by Sector Combined

	Residential	Nonresidential	Midstream	Renewables	Total
Incentive Costs[a]	$22,026,196	$26,184,660	$696,250	$4,460,461	$53,367,567
Administrative Costs	$1,181,238	$1,344,500	$37,339	$234,102	$2,797,178
Delivery Costs	$11,826,031	$18,182,952	$373,822	$2,747,356	$33,130,161
Incremental Measure Costs	$54,659,905	$108,544,464	$3,058,802	$46,423,479	$212,686,651
Total Non-Incentive Costs	**$67,667,175**	**$128,071,915**	**$3,469,963**	**$49,404,937**	**$248,613,990**
Electric Benefits	$59,379,444	$226,288,311	$1,705,596	$48,641,236	$336,014,587
Gas Benefits	$33,735,123	$67,981,083	$2,087,676	$3,163	$103,807,046
Emissions Benefits	$21,666,072	$63,671,512	$737,740	$7,573,857	$93,649,181
T&D Benefits	$7,031,358	$34,320,937	$248,592	$10,781,694	$52,382,582
Total TRC Benefits	**$121,811,997**	**$392,261,844**	**$4,779,605**	**$66,999,950**	**$585,853,396**
TRC Benefits Minus Costs	**$54,144,823**	**$264,189,928**	**$1,309,642**	**$17,595,013**	**$337,239,405**
TRC Ratio	**1.80**	**3.06**	**1.38**	**1.36**	**2.36**
TRC Ratio without T&D Benefits	**1.70**	**2.79**	**1.31**	**1.14**	**2.15**

[a] Incentive costs are shown for clarity, but are not included as part of mTRC costs for testing

Appendix B. Glossary of Terms

Term	Definition
Administrative Costs	Costs not directly associated with a specific program activity but necessary to the development and administration of programs, including record keeping, payroll, accounting, auditing, billing, business management, budgeting and related activities, overhead allocation, and other costs necessary to direct the organization of the program.
Attribution	The establishment of a causal relationship between action(s) taken by a group or program and an outcome. Being attributable to a program means that energy savings and demand reduction can be viewed as a result of the program's influence, and the savings would not have been achieved in the program's absence.
Avoided Costs	Costs the utility avoided by implementing an energy efficiency measure, program, or practice.
Baseline	Conditions (including energy consumption) that would have occurred without implementing the measure or project. These conditions can be either as-found (prior to the energy efficiency retrofit or to conditions that meet the state or federal efficiency codes) or a combination of efficient and nonefficient conditions derived from data.
Benefit/Cost Ratio	The mathematical relationship between the benefits and costs associated with implementing energy efficiency measures, programs, or practices or including emission reduction benefits resulting from such implementation.
Claimed Savings	Energy savings the offering administrator or offering implementer reports before verification by the evaluation team (also called *ex ante* savings, reported savings, or tracked savings).
Cost-Effectiveness	Comparison of the benefits and costs associated with implementing energy efficiency measures and programs. The actual benefits and costs included can vary based on the design and intent of different cost-effectiveness tests.
Custom Savings	Savings for nonprescriptive measures that do not meet the criteria for deemed savings as calculated by the offering administrator or offering implementer at the time of project completion. The result reflects savings for the specific project based on pre- and post-installation energy use.
Deemed Savings	An estimate of energy, demand, or natural gas savings for a single unit of an installed energy efficiency measure. Deemed savings are typically developed from data sources and analytical methods that are widely considered acceptable for the measure and are applicable to the situation.
Downstream Offering	An efficiency program that provides incentives to the end user by directly offsetting the first cost of the equipment and reducing the payback period.
Effective Useful Life	The median number of years of expected operation of a specific measure, i.e., the time until half the units would be expected to have failed or been removed
Estimated Savings	Savings estimated by an evaluator after conducting an energy impact evaluation.
***Ex Ante* Savings**	Energy savings the offering administrator or offering implementer reports before verification by the evaluation team (also called claimed savings, reported savings, or tracked savings).
***Ex Post* Evaluation**	An assessment of an activity's impact(s) after completion.
Freeriders	Participants who took part in an efficiency program but who would have adopted the energy-efficient measure in the program's absence. Freeriders can be total, partial, or deferred.
Gross Savings	The unadjusted program-reported change in energy consumption or demand resulting from efficiency program–related actions taken by participants.
Interactive Effects	The influence of one technology application on the energy required to operate another application.
Lifecycle Savings	Energy savings—expressed as verified gross or verified net—generated from measures installed in the current program cycle over each measure's effective useful life.

Term	Definition
Lifetime Savings	Energy savings—expressed as verified gross or verified net—produced as a result of measures installed in the current and previous program cycles, provided that the reporting period falls within each measure's useful life. This incorporates annual savings and each measure's effective useful life.
Locational Marginal Price	The marginal cost to serve a unit of energy at a specific location at the time of delivery.
Market Effects	Changes in marketplace practices, services, and promotional efforts that induce businesses and consumers to buy energy-saving products and services without direct offering assistance. Evaluators generally consider these effects as resulting from offering impacts on the market.
Market Lift	An increase in efficient product sales above a pre-established baseline in response to program incentives, promotion, or advertising.
Midstream Offering	An efficiency program that targets retailers, distributors, or both. Midstream programs are designed to encourage the targeted audience to stock, promote, and sell more energy-efficient products. Incentives are paid directly to the retailer or distributor.
Net Savings	Savings net of what would have occurred in the program's absence (observed impacts attributable to the program). Net savings are typically calculated by applying the net-to-gross ratio to the verified gross savings.
Net-to-Gross Ratio	The ratio of verified net savings (attributed to the program after evaluation) to the verified gross savings.
Non-Energy Benefits	An array of valued attributes, such as increased property values or reduced water usage, derived from energy-efficient measures in addition to energy savings.
Nonparticipant Spillover	The effect on eligible general consumers who did not participate in an efficiency program yet adopted energy-saving products or practices because of program influence.
Participant Spillover	The effect of participants who, after an initial program experience, adopt more energy-saving products or practices without program assistance.
Precision	The degree to which repeated measurements under unchanged conditions produce the same results.
Realization Rate	The ratio of gross savings to verified gross savings.
Reported Savings	Energy savings the offering administrator or offering implementer reports before verification by the evaluation team (also called tracked savings, *ex ante* savings, or claimed savings).
Resource Acquisition Offering	An efficiency program designed to directly achieve energy savings and/or demand reduction, as well as avoided emissions.
Standard Error	The measure of a data sample's variability (that is, the distance of a typical data point from the sample mean).
Tracked Savings	Energy savings the offering administrator or offering implementer reports before verification by the evaluation team (also called reported savings, *ex ante* savings, or claimed savings).
Unclaimed Rewards	Incentives set aside for customers who fail to submit paperwork to claim program incentives.
Upstream Offering	An efficiency program designed to encourage retailers and manufacturers to promote and sell more energy-efficient products. These programs provide incentives to retailers or manufacturers, which are passed through to customers.
Verified Gross Savings	Energy savings that are verified by an independent evaluation team and are based on inspections and reviews of the number and types of implemented energy efficiency measures and the engineering calculations used to estimate the energy saved. Verified gross savings reflect total calculated savings based on changes in energy consumption or demand resulting from program-related actions taken by participants in an efficiency program without considering the influence of freeridership or spillover.
Verified Net Savings	Energy savings that evaluators can confidently attribute to program efforts. To calculate verified net savings, the evaluation team makes adjustments for outside influences, such as freeridership and spillover.

Appendix C. Acronyms and Abbreviations

Acronym	Term
ADC	Average daily energy consumption
AIC	Akaike information criterion
AVERT	AVoided Emissions and geneRation Tool
BOD	Biological oxygen demand
BPK	Benefits per kilowatt-hour
Btu	British thermal unit
CDD	Cooling degree day
CF	Coincidence factor
cfm	Cubic feet per minute
CMAR	Compliance Maintenance Annual Report
COBRA	Co-Benefits Risk Assessment
CONE	Cost of New Entry
CY	Calendar year
DNR	Department of Natural Resources
EISA	Energy Independence and Security Act
EPA	U.S. Environmental Protection Agency
EUL	Effective useful life
EWG	Evaluation Work Group
GWh	Gigawatt hour
HDD	Heating degree day
HOU	Hours of use
ISR	In-service rate
kW	Kilowatt
kWh	Kilowatt hour
LED	Light-emitting diode
LMP	Locational marginal price
MGD	Millions of gallons per day
MISO	Midcontinent Independent Transmission System Operator
MMBtu	Million British thermal units
MMID	Master measure identification
MThm	Thousand therms
MW	Megawatt
MWh	Megawatts per hour
NAC	Normalized annual consumption
NOAA	National Atmospheric and Oceanographic Administration
NPSO	Nonparticipant spillover
NPV	Net present value
NTG	Net-to-gross
PRISM	PRInceton Scorekeeping Method
PSC	Public Service Commission of Wisconsin
PTAC	Packaged terminal air conditioner
PTHP	Packaged terminal heat pump
PV	Photovoltaic
RCx	Retrocommissioning
RIM	Ratepayer impact measure test
RTU	Remote terminal unit
SCADA	Supervisory Control and Data Acquisition
SEER	Seasonal energy efficiency rating
SEM	Strategic Energy Management
SPECTRUM	Statewide Program for Energy Customer Tracking, Resource Utilization, and Data Management
T&D	Transmission and distribution
TMY	Typical meteorological year
TRC	Total resource cost test
TRM	Technical reference manual
UAT	Utility administrator cost test
UEC	Unit energy consumption
UMP	Uniform Methods Project
VFD	Variable frequency drive
VSD	Variable speed drive
WRWA	Wisconsin Rural Water Association
WWTP	Wastewater treatment plant

Appendix D. CY 2022 Voluntary Program Efficiency Savings and Participation

In CY 2022, the Public Service Commission of Wisconsin (PSC) authorized Northern States Power-Wisconsin, We Energies, Wisconsin Power and Light, and Wisconsin Public Service Corporation to fund and operate voluntary programs in addition to the funding they contribute to Focus on Energy.

In general, these voluntary programs complement Focus on Energy offerings by providing bonus incentives on top of the existing Focus on Energy incentives or by offering additional energy efficiency savings opportunities for customers in the respective utility territories. For a number of these voluntary programs that build on existing offerings, their kilowatt, kilowatt-hour, and therms savings are not considered additive savings but are instead Focus on Energy portfolio savings achieved by the projects. Savings for We Energies' Voluntary Design Assistance Program are not currently claimed by Focus on Energy.

Table D-1 shows the CY 2022 program savings and participation for Northern States Power, We Energies, and Wisconsin Public Service.

Table D-1. CY 2022 Utility Voluntary Energy Efficiency Program Verified Gross Annual Savings and Participation

Program[a]	Participation	kW	kWh	therms
Northern States Power-Wisconsin Community Conservation Programs [b]	2,780	4,567	30,798,056	976,804
We Energies Voluntary Design Assistance Program	14	594	3,439,228	26,932
We Energies Residential Natural Gas Assistance Program [c]	129	N/A	44,072	25,196
Wisconsin Public Service Residential Assistance Program [d]	16	N/A	N/A	1,846

[a] CY 2022 participation and savings data for Wisconsin Power and Light's voluntary energy efficiency programs were not available at the time of the report. See Wisconsin PSC Docket 6680-EE-2022 for additional details.
https://apps.psc.wi.gov/ERF/ERFsearch/content/searchResult.aspx?UTIL=6680&CASE=EE&SEQ=2022&START=none&END=none&TYPE=none&SERVICE=none&KEY=none&NON=N

[b] See Northern States Power Wisconsin's 2022 Customer Service Conservation Report in Wisconsin PSC Docket 4220-EE-2022 for additional details.
https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=461506

[c] See We Energies' 2022 Customer Service Conservation Report in Wisconsin PSC Docket 5-EE-2022 for additional details.
https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=463347

[d] See Wisconsin Public Service Corporation's 2022 Customer Service Conservation Report in Wisconsin PSC Docket 6690-EE-2022 for additional details.
https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=463348

Appendix E. Detailed Findings

This section contains detailed first-year annual gross savings and lifecycle savings for the residential, nonresidential, and midstream channels as well as savings organized by offering and measure category.

Overview of Savings

Table E-1 lists the CY 2022 gross, verified gross, and verified net savings.

Table E-1. CY 2022 First-Year Annual Savings Split between Residential, Nonresidential, and Midstream

Savings Type	Unit	Residential	Nonresidential	Midstream	Total
Gross	MMBtu	1,419,534	2,353,414	39,631	3,812,579
	kWh	249,083,058	362,363,197	2,417,069	613,863,324
	kW	28,744	51,496	455	80,695
	therms	5,696,626	11,170,309	313,841	3,778,629
Verified Gross	MMBtu	1,423,128	2,315,870	39,631	3,778,629
	kWh	251,066,542	360,370,006	2,417,089	613,853,637
	kW	31,133	51,148	455	82,736
	therms	5,664,887	10,862,878	313,841	16,841,606
Verified Net	MMBtu	898,311	1,760,853	28,640	2,687,805
	kWh	134,552,827	274,220,682	1,782,568	410,556,078
	kW	14,074	38,530	270	52,873
	therms	4,392,171	8,252,121	225,580	12,869,872

Table E-2 lists the lifecycle savings achieved by Focus on Energy in CY 2022. Lifecycle savings represent the savings an offering can realize through measures, over these measures' effective useful life.

Table E-2. CY 2022 Lifecycle Savings Split between Residential, Nonresidential, and Midstream

Savings Type	Unit	Residential	Nonresidential	Midstream	Total
Gross	MMBtu	17,161,541	35,479,373	639,977	53,280,891
	kWh	2,477,268,231	5,476,936,313	38,775,745	7,992,980,288
	kW	28,744	51,496	455	80,695
	therms	87,091,017	167,920,663	5,076,743	260,088,423
Verified Gross	MMBtu	17,262,796	34,742,821	639,978	52,645,595
	kWh	2,483,080,424	5,444,218,647	38,776,105	7,966,075,175
	kW	31,133	51,148	455	82,736
	therms	87,905,255	161,671,468	5,076,743	254,653,466
Verified Net	MMBtu	11,104,204	26,459,762	479,193	38,043,160
	kWh	1,457,255,724	4,135,279,814	29,613,039	5,622,148,576
	kW	14,074	38,530	270	52,873
	therms	61,320,479	123,501,877	3,781,536	188,603,893

Summary of Savings by Offering

Table E-3 summarizes the first-year annual savings by offering.

Table E-3. Summary of First-Year Annual Savings by Offering, CY 2022

Solution Name	Offering Name	Gross			Verified Gross			Verified Net		
		kWh	kW	therms	kWh	kW	therms	kWh	kW	therms
Residential Offerings										
Direct to Customer	Online Marketplace	16,740,428	199	999,616	17,873,874	232	1,107,894	15,273,386	191	951,490
	Packs	30,385,486	3,047	1,695,540	30,259,352	3,030	1,556,721	26,011,219	2,618	1,501,806
	Retail	164,534,387	14,594	86,913	164,912,251	17,086	86,913	74,682,368	6,595	69,948
	Rural Retail Events	2,050,687	265	201,192	1,988,329	142	184,705	1,794,254	125	182,668
Trade Ally	Heating and Cooling	1,683,622	206	1,896,961	2,340,051	207	1,913,230	3,193,512	114	1,334,840
	Insulation and Air Sealing	2,847,166	789	331,472	2,851,402	789	330,492	2,897,290	812	327,171
	Renewable Energy, Residential Solar PV	25,094,243	8,493	-	25,094,243	8,493	-	10,700,798	3,620	-
New Construction	Residential New Construction	5,747,040	1,153	484,933	5,747,040	1,153	484,933	-	-	24,247
Residential Total		**249,083,058**	**28,744**	**5,696,626**	**251,066,542**	**31,133**	**5,664,887**	**134,552,827**	**14,074**	**4,392,171**
Midstream Offerings										
Midstream	Midstream	2,417,069	455	313,841	2,417,089	455	313,841	1,782,568	270	225,580
Midstream Total		**2,417,069**	**455**	**313,841**	**2,417,089**	**455**	**313,841**	**1,782,568**	**270**	**225,580**

Solution Name	Offering Name	Gross			Verified Gross			Verified Net		
		kWh	kW	therms	kWh	kW	therms	kWh	kW	therms
Nonresidential Offerings										
Business and Industry	Agribusiness	26,733,789	3,700	376,034	26,733,789	3,700	364,600	22,988,764	3,182	313,600
	Commercial and Industrial	103,701,111	13,373	2,861,285	102,664,100	13,106	2,861,285	79,051,357	10,091	2,203,189
	Renewable Energy, Nonresidential	2,520	0	369	2,495	0	369	1,921	0	284
	Large Industrial	94,649,556	11,137	4,258,467	94,649,556	11,248	4,002,959	70,040,671	8,324	2,962,190
Schools and Government	Government	349,30,863	3,894	527,343	34,930,863	3,894	442,968	25,499,530	2,842	323,367
	Schools	24,971,335	3,827	16,92,262	24,471,908	3,827	1,675,340	17,864,493	2,793	1,222,998
	Schools and Government	1,032,699	35	14,081	1,017,402	35	11,828	742,703	25	8,634
New Construction	Prescriptive	13,891,146	2,274	389,434	13,891,146	2,297	389,434	11,251,828	1,860	315,442
	Whole Building Review	44,143,170	7,133	1,051,034	43,701,738	6,919	1,114,096	35,398,408	5,605	902,418
Trade Ally	Renewable Energy, Nonresidential Solar PV	18,307,008	6,124	0	18,307,008	6,124	0	11,381,006	3,807	0
Nonresidential Total		**362,363,197**	**51,496**	**11,170,309**	**360,370,006**	**51,148**	**10,862,878**	**274,220,682**	**38,530**	**8,252,121**
Total All Offerings		**613,863,324**	**80,695**	**17,180,775**	**613,853,637**	**82,736**	**16,841,606**	**410,556,078**	**52,873**	**12,869,872**

Table E-4 summarizes the lifecycle savings by offering.

Table E-4. Summary of Lifecycle Savings by Offering, CY 2022

Solution Name	Offering Name	Gross		Verified Gross		Verified Net	
		kWh	therms	kWh	therms	kWh	therms
Residential Offerings							
Direct to Consumer	Online Marketplace	144,190,068	9,050,992	152,870,093	10,022,524	130,932,226	8,606,382
	Packs	223,297,165	17,471,828	222,639,535	17,428,061	197,754,121	16,736,951
	Retail	1,225,994,502	945,822	1,217,314,729	945,772	740,854,564	732,505
	Rural Retail	15,917,735	2,025,858	15,326,163	1,861,066	14,237,212	1,837,720
Trade Ally	Heating and Cooling	(6,206,271)	34,777,495	824,568	34,823,289	30,708,389	24,473,920
	Insulation and Air Sealing	73,967,827	8,281,713	73,998,131	8,287,234	75,120,635	8,206,135
	Renewable Energy, Residential Solar PV	627,662,303	-	627,662,303	-	267,648,577	-
New Construction	Residential New Construction	172,444,902	14,537,310	172,444,902	14,537,310	-	726,866

Solution Name	Offering Name	Gross		Verified Gross		Verified Net	
		kWh	therms	kWh	therms	kWh	therms
Residential Total		2,477,268,231	87,091,017	2,483,080,424	87,905,255	1,457,255,724	61,320,479
Midstream Offerings							
Midstream	Midstream	38,775,745	5,076,743	38,776,105	5,076,743	29,613,039	3,781,536
Midstream Total		38,775,745	5,076,743	38,776,105	5,076,743	29,613,039	3,781,536
Nonresidential Offerings							
Business and Industry	Agribusiness	438,053,748	6,727,264	438,053,295	6,525,588	376,724,372	5,612,486
	Commercial and Industrial	1,365,278,253	42,085,808	1,351,625,471	42,927,524	1,040,751,612	33,054,194
	Renewable Energy, Nonresidential	50,400	7,380	49,896	7,528	38,420	5,796
	Large Industrial	1,287,211,558	57,398,921	1,287,211,558	53,954,986	952,536,553	39,926,689
Schools and Government	Government	491,787,601	8,723,126	491,787,601	6,978,500	359,004,949	5,094,305
	Schools	337,352,307	24,324,363	327,231,738	21,405,440	238,879,169	15,625,971
	Schools & Government	7,031,611	215,700	6,916,887	172,560	5,049,328	125,969
New Construction	Prescriptive	882,863,400	21,020,680	874,034,766	22,281,921	707,968,160	18,048,356
	Whole Building Review	209,632,228	7,417,421	209,632,228	7,417,421	169,802,105	6,008,111
Trade Ally	Renewable Energy, Nonresidential Solar PV	457,675,208	-	457,675,208	-	284,525,147	-
Nonresidential Total		5,476,936,313	167,920,663	5,444,218,647	161,671,468	4,135,279,814	123,501,877
Total All Offerings		**7,992,980,288**	**260,088,423**	**7,966,075,175**	**254,653,466**	**5,622,148,576**	**188,603,893**

Summary of Savings by Measure

Table E-5 summarizes CY 2022 residential savings by measure category.

Table E-5. Summary of First-Year Annual Savings by Measure Category, Residential Channel

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Boilers & Burners-Boiler	0	0.00%	0	0.00%	165,540	2.92%	$289,925	1.19%
Boilers & Burners-Controls	2,548	0.00%	0	0.00%	559	0.01%	$650	0.00%
Boilers & Burners-Tune-up/Repair/Commissioning	0	0.00%	0	0.00%	185	0.00%	$621	0.00%
Building Shell-Air Sealing	226,307	0.09%	11	0.03%	37,994	0.67%	$864,453	3.56%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Building Shell-Bonus	0	0.00%	0	0.00%	0	0.00%	$112,800	0.46%
Building Shell-Insulation	2,639,031	1.05%	778	2.50%	315,029	5.56%	$1,099,027	4.52%
Domestic Hot Water-Aeration	4,884,530	1.95%	258	0.83%	961,912	16.98%	$483,144	1.99%
Domestic Hot Water-Bonus	0	0.00%	0	0.00%	0	0.00%	$167,500	0.69%
Domestic Hot Water-Insulation	3,862,995	1.54%	706	2.27%	459,860	8.12%	$444,853	1.83%
Domestic Hot Water-Other	209,463	0.08%	28	0.09%	85,959	1.52%	$174,595	0.72%
Domestic Hot Water-Showerhead	1,609,359	0.64%	79	0.25%	314,226	5.55%	$344,082	1.42%
Domestic Hot Water-Water Heater	0	0.00%	0	0.00%	36,090	0.64%	$115,100	0.47%
HVAC-Air Conditioner - Residential	1,497	0.00%	3	0.01%	0	0.00%	$2,218	0.01%
HVAC-Bonus	0	0.00%	0	0.00%	0	0.00%	$750	0.00%
HVAC-Controls	20,714,902	8.25%	0	0.00%	1,401,443	24.74%	$2,235,783	9.20%
HVAC-Furnace	2,395,290	0.95%	0	0.00%	773,331	13.65%	$2,550,800	10.50%
HVAC-Other	-5,529,453	-2.20%	191	0.61%	625,823	11.05%	$1,420,747	5.85%
HVAC-Packaged Terminal Unit (PTAC, PTHP)	100,510	0.04%	12	0.04%	0	0.00%	$4,600	0.02%
HVAC-Tune-up/Repair/Commissioning	0	0.00%	0	0.00%	2,002	0.04%	$17,338	0.07%
Lighting-Light Emitting Diode (LED)	185,790,531	74.00%	18,985	60.98%	0	0.00%	$7,806,469	32.12%
Motors & Drives-Motor	6,640	0.00%	1	0.00%	0	0.00%	$400	0.00%
New Construction-Whole Building	5,747,040	2.29%	1,153	3.70%	484,933	8.56%	$2,096,362	8.63%
Other-Bonus	0	0.00%	0	0.00%	0	0.00%	$993,013	4.09%
Renewable Energy-Photovoltaics	25,094,243	10.00%	8,493	27.28%	0	0.00%	$2,150,386	8.85%
Vending & Plug Loads-Controls	3,201,577	1.28%	422	1.36%	0	0.00%	$904,752	3.72%
Vending & Plug Loads-Filtration	109,532	0.04%	12	0.04%	0	0.00%	$21,050	0.09%

Table does not include adjustment measure records. As a result, this sum will not match with other CY 2022 totals.

Table E-6 lists CY 2022 nonresidential savings by measure category.

Table E-6. Summary of First-Year Annual Savings by Measure Category, Nonresidential Channel

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Aeration	192,781	0.05%	22	0.04%	0	0.00%	$9,912	0.02%
Air Sealing	0	0.00%	0	0.00%	12,821	0.12%	$5,560	0.01%
Air Turnover Unit	2,430	0.00%	0	0.00%	5,738	0.05%	$4,689	0.01%
Biogas [a]	0	0.00%	0	0.00%	0	0.00%	$12,000,000	29.47%
Boiler	0	0.00%	0	0.00%	1,613,024	14.85%	$1,654,901	4.06%
Bonus	0	0.00%	0	0.00%	0	0.00%	$1,825,028	4.48%
Chiller	1,773,786	0.49%	271	0.53%	0	0.00%	$193,457	0.48%
Compressor	8,417,196	2.34%	1,377	2.69%	0	0.00%	$292,580	0.72%
Controls	11,414,911	3.17%	665	1.30%	667,816	6.15%	$828,290	2.03%
Delamping	282,951	0.08%	58	0.11%	0	0.00%	$17,305	0.04%
Design	18,674,437	5.18%	3,199	6.25%	370,961	3.41%	$2,092,247	5.14%
Direct Fired Heating	0	0.00%	0	0.00%	105,088	0.97%	$67,950	0.17%
Dryer	1,466,602	0.41%	200	0.39%	335,012	3.08%	$619,011	1.52%
Economizer	343,392	0.10%	40	0.08%	0	0.00%	$6,868	0.02%
Energy Recovery	200,385	0.06%	148	0.29%	2,066,955	19.03%	$1,423,991	3.50%
Fan	5,923,190	1.64%	1,069	2.09%	0	0.00%	$275,795	0.68%
Filtration	249,770	0.07%	-242	-0.47%	625,982	5.76%	$472,710	1.16%
Furnace	12,045	0.00%	0	0.00%	46,805	0.43%	$34,140	0.08%
Greenhouse	0	0.00%	0	0.00%	33,225	0.31%	$15,736	0.04%
Heat Exchanger	1,273,478	0.35%	0	0.00%	0	0.00%	$79,029	0.19%
Infrared Heater	0	0.00%	0	0.00%	12,316	0.11%	$18,048	0.04%
Insulation	0	0.00%	0	0.00%	88,636	0.82%	$58,971	0.14%
Irrigation	65,732	0.02%	28	0.05%	0	0.00%	$7,475	0.02%
Light Emitting Diode (LED)	157,639,244	43.74%	20,827	40.72%	0	0.00%	$6,938,064	17.04%
Livestock Waterer	347,776	0.10%	0	0.00%	0	0.00%	$9,520	0.02%
Motor	759,191	0.21%	105	0.20%	0	0.00%	$20,780	0.05%

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Nozzle	93,393	0.03%	22	0.04%	0	0.00%	$690	0.00%
Other	37,739,333	10.47%	4,264	8.34%	2,573,844	23.69%	$4,437,795	10.90%
Packaged Terminal Unit (PTAC, PTHP)	630,325	0.17%	30	0.06%	0	0.00%	$20,415	0.05%
Photovoltaics	18,307,008	5.08%	6,124	11.97%	0	0.00%	$2,210,297	5.43%
Pump	554,220	0.15%	79	0.15%	0	0.00%	$29,943	0.07%
Reconfigure Equipment	3,320,299	0.92%	673	1.32%	0	0.00%	$169,231	0.42%
Refrigerated Case Door	2,402,234	0.67%	363	0.71%	193,708	1.78%	$168,900	0.41%
Rooftop Unit/Split System AC	1,828,871	0.51%	596	1.17%	131,025	1.21%	$343,177	0.84%
Scheduling	1,016,198	0.28%	20	0.04%	50,015	0.46%	$65,519	0.16%
Solar Thermal	2,495	0.00%	0	0.00%	369	0.00%	$1,623	0.00%
Specialty Pulp & Paper	752,666	0.21%	90	0.18%	0	0.00%	$35,000	0.09%
Steam Trap	0	0.00%	0	0.00%	603,338	5.55%	$78,453	0.19%
Supporting Equipment	167,178	0.05%	14	0.03%	0	0.00%	$6,808	0.02%
System Isolation	324,053	0.09%	0	0.00%	0	0.00%	$6,481	0.02%
Tune-up/Repair/Commissioning	11,406,149	3.17%	0	0.00%	508,317	4.68%	$180,941	0.44%
Unit Heater	192,444	0.05%	0	0.00%	732	0.01%	$7,820	0.02%
Variable Speed Drive	46,082,597	12.79%	7,034	13.75%	0	0.00%	$1,211,658	2.98%
Water Heater	13,258	0.00%	1	0.00%	20,574	0.19%	$42,556	0.10%
Welder	76,918	0.02%	9	0.02%	0	0.00%	$3,955	0.01%
Whole Building	26,421,067	7.33%	4,065	7.95%	796,579	7.33%	$2,722,191	6.69%

Table does not include adjustment measure records. As a result, this sum will not match with other CY 2022 totals.

[a] The information presented for the biogas category represents the incentive payment made to BC Organics LLC for achieving substantial completion status of an integrated anaerobic digester project first approved through a competitive grant awarded by the PSC in 2017 in docket 5-FE-100. (PSC REF#: 331578.) Focus on Energy is not claiming energy savings for this project.

Table E-7 lists CY 2022 midstream savings by measure category.

Table E-7. Summary of First-Year Annual Savings by Measure Category, Midstream Channel

Measure Category	Verified Gross						Incentive Dollars	Incentive Dollars %
	kWh	kWh %	kW	kW %	Therms	Therms %		
Bonus	0	0.00%	0	0.00%	0	0.00%	$5,550	0.80%
Dishwasher, Commercial	354,705	14.67%	17	3.80%	0	0.00%	$10,850	1.56%
Domestic Hot Water-Water Heater	3,312	0.14%	0	0.03%	271	0.09%	$3,200	0.46%
Fryer	0	0.00%	0	0.00%	76,738	24.45%	$85,400	12.27%
Hot Holding Cabinet	3,262	0.13%	1	0.22%	0	0.00%	$600	0.09%
HVAC-Other[a]	1,600,470	66.21%	122	26.74%	200,718	63.96%	$411,500	59.10%
Ice Machine	4,415	0.18%	1	0.11%	0	0.00%	$200	0.03%
Other	33,792	1.40%	17	3.83%	17,236	5.49%	$30,000	4.31%
Other-Bonus	0	0.00%	0	0.00%	0	0.00%	$45,900	6.59%
Oven	23,428	0.97%	5	1.18%	15,554	4.96%	$19,200	2.76%
Steamer	166,960	6.91%	278	61.05%	726	0.23%	$23,600	3.39%
Variable Speed Drive	226,745	9.38%	14	3.03%	0	0.00%	$47,050	6.76%
Water Heater	0	0.00%	0	0.00%	2,598	0.83%	$13,200	1.90%

Note: Table does not include adjustment measure records. As a result, this sum will not match with other CY 2022 totals.
[a] HVAC-Other in the Midstream Channel is made up of exclusively ductless minisplit heat pumps.

Table E-8 lists CY 2022 residential lifecycle savings by measure category.

Table E-8. Summary of Lifecycle Savings by Measure Category, Residential Channel

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Boilers & Burners-Boiler	0	0.00%	4,156,726	4.73%
Boilers & Burners-Controls	22,932	0.00%	5,031	0.01%
Boilers & Burners-Tune-up/Repair/Commissioning	0	0.00%	370	0.00%
Building Shell-Air Sealing	3,394,607	0.14%	569,915	0.65%
Building Shell-Bonus	0	0.00%	0	0.00%
Building Shell-Insulation	70,812,570	2.85%	8,055,281	9.16%
Domestic Hot Water-Aeration	48,845,623	1.97%	9,619,125	10.94%
Domestic Hot Water-Bonus	0	0.00%	0	0.00%
Domestic Hot Water-Insulation	57,962,031	2.33%	6,897,905	7.85%
Domestic Hot Water-Other	837,852	0.03%	343,836	0.39%
Domestic Hot Water-Showerhead	16,093,587	0.65%	3,142,257	3.57%
Domestic Hot Water-Water Heater	0	0.00%	504,472	0.57%
HVAC-Air Conditioner - Residential	2,994	0.00%	0	0.00%
HVAC-Bonus	0	0.00%	0	0.00%
HVAC-Controls	187,039,437	7.53%	12,653,970	14.40%
HVAC-Furnace	49,958,053	2.01%	16,126,311	18.35%
HVAC-Other	-99,413,907	-4.00%	11,288,742	12.84%
HVAC-Packaged Terminal Unit (PTAC, PTHP)	1,507,650	0.06%	0	0.00%
HVAC-Tune-up/Repair/Commissioning	0	0.00%	4,004	0.00%
Lighting-Light Emitting Diode (LED)	1,325,550,585	53.38%	0	0.00%
Motors & Drives-Motor	119,520	0.00%	0	0.00%
New Construction-Whole Building	172,444,902	6.94%	14,537,310	16.54%
Other-Bonus	0	0.00%	0	0.00%
Renewable Energy-Photovoltaics	627,662,303	25.28%	0	0.00%
Vending & Plug Loads-Controls	19,253,898	0.78%	0	0.00%
Vending & Plug Loads-Filtration	985,788	0.04%	0	0.00%

Table E-9 lists CY 2022 nonresidential lifecycle savings by measure category.

Table E-9. Summary of Lifecycle Savings by Measure Category, Nonresidential Channel

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Aeration	3,855,620	0.07%	0	0.00%
Air Sealing	0	0.00%	180,655	0.11%
Air Turnover Unit	36,457	0.00%	87,791	0.05%
Biogas	0	0.00%	0	0.00%
Boiler	0	0.00%	36,709,104	22.71%
Bonus	0	0.00%	0	0.00%
Chiller	35,588,321	0.65%	0	0.00%
Compressor	112,631,538	2.07%	0	0.00%
Controls	117,221,463	2.15%	9,131,559	5.65%
Delamping	3,395,411	0.06%	0	0.00%
Design	373,488,746	6.86%	7,419,216	4.59%
Direct Fired Heating	0	0.00%	1,568,720	0.97%
Dryer	22,838,213	0.42%	6,739,411	4.17%
Economizer	5,494,272	0.10%	0	0.00%
Energy Recovery	2,415,319	0.04%	29,486,900	18.24%
Fan	88,871,709	1.63%	0	0.00%
Filtration	810,315	0.01%	9,501,008	5.88%
Furnace	229,799	0.00%	928,383	0.57%
Greenhouse	0	0.00%	417,755	0.26%
Heat Exchanger	19,102,170	0.35%	0	0.00%
Infrared Heater	0	0.00%	184,521	0.11%
Insulation	0	0.00%	1,492,056	0.92%
Irrigation	985,980	0.02%	0	0.00%
Light Emitting Diode (LED)	2,332,046,806	42.84%	0	0.00%
Livestock Waterer	3,477,760	0.06%	0	0.00%
Motor	11,714,281	0.22%	0	0.00%
Nozzle	1,400,895	0.03%	0	0.00%
Other	462,636,989	8.50%	32,617,199	20.17%
Packaged Terminal Unit (PTAC, PTHP)	9,454,878	0.17%	0	0.00%
Photovoltaics	457,675,208	8.41%	0	0.00%
Pump	8,313,300	0.15%	0	0.00%
Reconfigure Equipment	43,819,339	0.80%	0	0.00%
Refrigerated Case Door	31,834,805	0.58%	2,962,376	1.83%
Rooftop Unit/Split System AC	27,143,692	0.50%	1,680,392	1.04%
Scheduling	6,995,303	0.13%	283,718	0.18%
Solar Thermal	49,896	0.00%	7,528	0.00%
Specialty Pulp & Paper	11,289,990	0.21%	0	0.00%
Steam Trap	0	0.00%	3,559,723	2.20%
Supporting Equipment	835,892	0.02%	0	0.00%
System Isolation	3,240,530	0.06%	0	0.00%

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Tune-up/Repair/Commissioning	22,298,856	0.41%	459,930	0.28%
Unit Heater	2,886,660	0.05%	11,871	0.01%
Variable Speed Drive	690,544,156	12.68%	0	0.00%
Water Heater	172,355	0.00%	310,065	0.19%
Welder	999,934	0.02%	0	0.00%
Whole Building	528,421,790	9.71%	15,931,585	9.85%

Table E-10 lists CY 2022 midstream lifecycle savings by measure category.

Table E-10. Summary of Lifecycle Savings by Measure Category, Midstream Channel

Measure Category	Verified Gross			
	kWh	kWh %	Therms	Therms %
Dishwasher, Commercial	3,547,050	9.15%	0	0.00%
Domestic Hot Water-Water Heater	43,056	0.11%	3,523	0.07%
Fryer	0	0.00%	920,856	18.14%
Hot Holding Cabinet	39,144	0.10%	0	0.00%
HVAC-Other	28,808,467	74.29%	3,612,924	71.17%
Ice Machine	44,150	0.11%	0	0.00%
Other	608,249	1.57%	310,248	6.11%
Other-Bonus	0	0.00%	0	0.00%
Oven	281,138	0.73%	186,658	3.68%
Steamer	2,003,684	5.17%	8,742	0.17%
Variable Speed Drive	3,401,167	8.77%	0	0.00%
Water Heater	0	0.00%	33,792	0.67%

Appendix F. Measure Analysis

This appendix describes the analyses of measures delivered by specific Focus on Energy offerings during CY 2022. It describes the methodologies the evaluation team followed and the results of the evaluation.

The evaluation team estimated per-unit savings for LEDs in the Direct to Customer Solution and for smart thermostats in the Trade Ally and Direct to Customers solutions. The team also analyzed realization rates for a sample of projects from these nonresidential offerings—Large Industrial, Commercial and Industrial, Agribusiness, Schools, Government, Prescriptive, and Energy Design Assistance/Energy Design Review.

Direct to Customer Solution: Lighting Analysis

In CY 2022, the evaluation team estimated LED per-bulb savings for Direct to Customer Solution's Retail, Rural Retail Events, and Online Marketplace offerings using the lumen equivalence methodology to determine baseline wattages and other inputs from the 2022 Wisconsin Technical Reference Manual (TRM).

Unit Energy Savings Inputs

Table F-1 shows the values used to calculate verified gross savings. The evaluation team used items in the rows under the unit savings inputs heading to calculate savings for individual bulbs and applied the items in the rows under the total savings inputs heading to aggregated savings.

Table F-1. CY 2022 Lighting Verified Gross Inputs

Input	Description	Offering	Residential Value	Nonresidential Value	Units	Source
Unit Savings Inputs						
HOU	Hours of use: daily average use LEDs	Retail	2.20	10.20	Hours/ day	2022 TRM
		Online Marketplace	SF: 2.27 MF: 2.01	N/A		
ISR_{LED}	In-service rate: percentage of LEDs installed	All	Varies	Varies	%	Retail: 2022 TRM Online Marketplace: 2020 Participant Survey
Δwatts	Delta watts: difference in wattage between the efficient and baseline bulb	All	Varies	Varies	W	Wisconsin CY 2022 lumen equivalence analysis
CF	Coincidence factor: summer peak coincidence factor	Retail	0.070	0.770	-	2022 TRM
		Online Marketplace	SF: 0.075 MF: 0.055	N/A		
365	Days per year: conversion to annualize the daily hours of use	All	365	365	Days/ year	2022 TRM

Input	Description	Offering	Residential Value	Nonresidential Value	Units	Source
Total Savings Inputs						
Cross-Sector Sales	Cross-sector sales: percentage of bulbs sales allocated to the residential and nonresidential sectors	Retail	93.4	6.6	%	Wisconsin CY 2015 cross-sector sales analysis
EUL_{LED}	Effective useful life: average life of a LED bulb	All	GSL = 5 Reflector = 4 Specialty = 8 IQ GSL = 11 IQ Specialty and Reflector = 10	GSL = 5 Reflector = 4 Specialty = 8	Years	2022 TRM

GSL = general service light, IQ = income-qualified, MF = multifamily, SF = single-family.

Table F-2 lists the measure-specific in-service rates (ISRs) the evaluation team applied to all LED measures.

Table F-2. CY 2022 Lighting Verified In-Service Rates

Offering	Measure Name	Verified First-Year ISR	Verified Lifetime ISR	Verified ISR Source	*Ex Ante* ISR
Retail – Retail Lighting	All LEDs	56%	87%	TRM	87%
Retail – Income Qualified	All LEDs	N/A	78%	TRM	78%
Retail - Pop-Up Retail Rural Retail	LED A-Line 60W Equivalent	72%	92%	CY 2020 participant survey	87%
	LED A-Line 75W Equivalent	67%	90%		87%
	LED A-Line 100W Equivalent	58%	88%		87%
	LED A-Line High Wattage[a]	65%	90%	CY 2020 participant survey average of other lamp types	87%
	LED 3-Way	57%	88%	CY 2020 participant survey	87%
	LED Candelabra	59%	88%		87%
	LED Globe	61%	89%		87%
	LED Reflector	64%	90%		87%
	LED Desk Lamp	80%	94%		87%
Online Marketplace	LED, Omnidirectional, Standard, Online Store	SF: 59% MF: 50%	SF: 86% MF: 84%	CY 2021 participant survey	87%
	LED, Reflector, Online Store	SF: 58% MF: 38%	SF: 86% MF: 80%		87%
	LED, Globe, Online Store	SF: 53% MF: 66%	SF: 85% MF: 88%		87%
	LED, Decorative, Online Store	SF: 61% MF: 50%	SF: 87% MF: 84%		87%
	LED, 3-way, Online Store	SF: 61% MF: 50%	SF: 87% MF: 84%		87%

[a] New starting CY 2021, so this measure was not included in the 2020 survey.

In the Retail Offering, verified inputs for Retail Lighting savings include 6.6% cross-sector sales to account for program bulbs sold through participating retailers that participants installed in nonresidential locations. To determine verified savings, the evaluation team calculated residential and nonresidential savings independently and used these percentages to weight the savings for each residential and nonresidential measure.

For Pop-Up Retail and Income Qualified offerings, the evaluation team only applied residential savings. The team assumed that bulbs distributed through Income Qualified channels would be installed only in homes, and the CY 2020 Pop-Up Retail participant survey found that participants installed bulbs only in residential applications. Table F-3 shows the weighted verified savings for the Retail Lighting Offering.

Table F-3. CY 2022 Retail Lighting Offering Weighted Verified Gross Unit Savings

Measure	kWh	kW
LED, Reflector	43	0.005
LED, Globe	31	0.003
LED, Decorative	32	0.004
LED, 3-Way	69	0.008
LED, Omnidirectional, 310–749 Lumens	18	0.002
LED, Omnidirectional, 750–1,049 Lumens	24	0.002
LED, Omnidirectional, 1,050–1,489 Lumens	34	0.004
LED, Omnidirectional, 1,490–2,600 Lumens	44	0.005
LED, Omnidirectional, 2,601–5,000 Lumens	108	0.011

Notes: No natural gas savings were claimed for the offering. Unit savings were weighted by the evaluated cross-sector sales percentage.

LEDs distributed through Rural Retail pop-up events use the same inputs as the Pop-Up Retail events in the Retail Offering. Therefore, the team applied residential savings only to bulbs in the Rural Retail Events Offering.

The CY 2021 participant survey of the Online Marketplace Offering also found that participants installed bulbs only in residential applications. Therefore, the evaluation team applied residential savings only to bulbs distributed through the Online Marketplace.

Table F-4 shows the verified residential savings for Rural Retail events and the Online Marketplace Offering.

Table F-4. CY 2022 Pop-Up Retail, Rural Retail Events, and Online Marketplace Verified Gross Unit Savings

Offering	Measure	kWh	kW
Rural Retail Events	LED, Reflector	37	0.003
	LED, Globe	27	0.002
	LED, Decorative	26	0.002
	LED, 3-Way	59	0.005
	LED, Omnidirectional, 310–749 Lumens	17	0.001
	LED, Omnidirectional, 750–1,049 Lumens	25	0.002
	LED, Omnidirectional, 1,050–1,489 Lumens	31	0.003
	LED, Omnidirectional, 1,490–2,600 Lumens	41	0.004
	LED, Omnidirectional, 2,601–5,000 Lumens	107	0.009
Online Marketplace	LED, Reflector, Online Store	SF: 45 MF: 40	SF: 0.0041 MF: 0.0030
	LED, Globe, Online Store	SF: 30 MF: 26	SF: 0.0027 MF: 0.0020
	LED, Decorative, Online Store	SF: 25 MF: 22	SF: 0.0023 MF: 0.0017
	LED, 3-way, Online Store	SF: 53 MF: 47	SF: 0.0048 MF: 0.0035
	LED, Omnidirectional, 310-749 Lumens, Online Store	SF: 17 MF: 15	SF: 0.0016 MF: 0.0011
	LED, Omnidirectional, 750-1,049 Lumens, Online Store	SF: 45 MF: 40	SF: 0.0041 MF: 0.0030
	LED, Omnidirectional, 1,050-1,489 Lumens, Online Store	SF: 40 MF: 35	SF: 0.0036 MF: 0.0026
	LED, Omnidirectional, 1,490-2,600 Lumens, Online Store	SF: 47 MF: 42	SF: 0.0043 MF: 0.0031
	Connected Lighting Pack, Omnidirectional, Online Store	SF: 29 MF: 26	SF: 0.0042 MF: 0.0042

Table F-5 shows baseline and efficient wattages and the corresponding delta watts for the Retail, Rural Retail, and Online Marketplace offerings' *ex ante* and verified savings.

Table F-5. Comparison of CY 2022 Retail, Rural Retail Events, and Online Marketplace *Ex Ante* and Verified Delta Watts

Offering	Measure	Baseline		Bulb Wattage		Delta Watts	
		Ex Ante	Average Evaluated	*Ex Ante*	Average Evaluated	*Ex Ante*	Average Evaluated
Retail	LED, Reflector	61	62	9	9	52	53
	LED, Globe	39	42	5	5	35	37
	LED, Decorative	45	42	4	4	41	38
	LED, 3-Way	61	97	15	16	46	82
	LED, Omnidirectional, 310–749 Lumens	29	29	6	6	23	23
	LED, Omnidirectional, 750–1,049 Lumens	43	43	9	9	34	34
	LED, Omnidirectional, 1,050–1,489 Lumens	53	53	11	10	42	43
	LED, Omnidirectional, 1,490–2,600 Lumens	58	72	13	15	56	57
	LED, Omnidirectional, 2,601–5,000 Lumens	61	165	9	28	97	137
Rural Retail Events	LED, Reflector	61	62	9	11	52	51
	LED, Globe	39	43	5	6	35	38
	LED, Decorative	45	40	4	4	41	36
	LED, 3-Way	61	100	15	16	46	84
	LED, Omnidirectional, 310–749 Lumens	29	25	6	3	23	22
	LED, Omnidirectional, 750–1,049 Lumens	43	43	9	9	34	34
	LED, Omnidirectional, 1,050–1,489 Lumens	53	53	11	11	42	42
	LED, Omnidirectional, 1,490–2,600 Lumens	58	72	13	14	56	58
	LED, Omnidirectional, 2,601–5,000 Lumens	61	179	9	31	97	148
Online Marketplace	LED, Reflector	61	65	9	9.5	52.3	54.5
	LED, Globe	39	40	5	4	35	36.0
	LED, Decorative	45	40	4	9.5	41	30.5
	LED, 3-Way	60	60	15	9	46	64.2
	LED, Omnidirectional, 310–749 Lumens	29	25	6	4	23	20.8
	LED, Omnidirectional, 750–1,049 Lumens	43	44	9	9	34	34.1
	LED, Omnidirectional, 1,050–1,489 Lumens	53	65	11	17	42	48.0
	LED, Omnidirectional, 1,490–2,600 Lumens	58	72	13	15	56	57.0

Delta Watts Lumens Bins

This section provides details related to lumen bins, which the evaluation team used for calculating verified delta watts inputs. The lumen bins for specialty bulbs shown in Table F-6, Table F-7, and Table F-8 are derived from the U.S. Department of Energy Uniform Methods Project (UMP).[9] The baselines are derived from the Energy Independence and Security Act (EISA).

Table F-6. Globe Lumen Bins

Bin	Baseline (EISA-Impacted Bulbs)
250–349	25
350–499	29
500–574	43
575–649	53
650–1,099	72
1,100–1,300	72

Table F-7. Decorative Shape (Candles) Lumen Bins

Bin	Baseline (EISA-Impacted Bulbs)
70–89	10
90–149	15
150–299	25
300–499	29
500–699	43

Table F-8. Three-Way, Post Lamps, and Other Similar Bulbs Lumen Bins

Bin	Baseline (EISA-Exempt Bulbs)
0–309	25
310–449	25
450–799	40
800–1099	60
1,100–1,599	75
1,600–1,999	100
2,000–2,600	150
2,601–3,300	150
3,301–4,815	200

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9 National Renewable Energy Laboratory. 2015. "Chapter 21: Residential Lighting Evaluation Protocol." *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf

Residential Solutions: Smart Thermostat Billing Analysis

The evaluation team conducted a billing analysis to estimate gross savings for smart thermostat measures in the Trade Ally and Direct to Customer solutions. The team previously performed a similar smart thermostat billing analysis for the CY 2016 Smart Thermostat Pilot. Results from the CY 2016 billing analysis are the basis for deemed thermostat savings in the 2022 TRM.

To conduct the CY 2022 billing analysis, the evaluation team used regression models to measure the impact of smart thermostat installations on energy consumption. Accounting for weather in the process, the team evaluated pre- and post-installation energy consumption to measure the impact of smart thermostats on participant consumption. The team included January 2020 through September 30, 2021 participants in the analysis because these participants had sufficient pre- and post-period billing data.[10]

The savings estimates from the billing analysis are gross savings estimates. The evaluation team identified a nonparticipant group of thermostat participants from CY 2021 Q4 to CY 2022 Q2 to estimate adjusted gross savings by comparing the change in energy consumption for participants to nonparticipants. However, the nonparticipant group had a substantial increase in usage in the post-period due to the impact of COVID-19. The nonparticipant pre-period heating season was primarily from October 2019 through March 2020, while the post-period heating season was from October 2020 through March 2021. A separate nonparticipant group was not available, and the nonparticipant heating season could not be changed because many nonparticipants later received a thermostat.

The billing analyses evaluated gross natural gas and electric savings for smart thermostat measures. The evaluation team also considered three heating system types: furnaces, boilers, and heat pumps. These are consistent with the measure categories currently in the Wisconsin TRM.

For each participant, the team obtained these data:

- SPECTRUM ID and customer ID
- Customer name and address including zip code
- Minimum measure installation date

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10 The evaluation team received **natural gas** billing data from the following utilities: Madison Gas and Electric, Midwest Natural Gas Incorporated, Northern States Power Company (Xcel), Superior Water Light and Power Co, Wisconsin Electric Power Company (WE Energies), Wisconsin Power and Light (Alliant), and Wisconsin Public Service Corporation. The evaluation team received **electric** billing data from the following utilities: Arcadia Electric & Water Utility, Bangor Municipal Utility, Belmont Municipal Water and Electric Utility, Benton Municipal Electric and Water Utility, Black Earth Electric Utility, Consolidated Water Power Company, Cornell Municipal Water and Electric Utility, Cumberland Municipal Utility, Madison Gas and Electric Company, Manitowoc Public Utilities, Marshfield Utilities, Mazomanie Electric Utility, Northern States Power Company (Xcel), Rice Lake Municipal Water & Electric Utility, Rock Energy Cooperative, Shawano Municipal Utilities, Sheboygan Falls Utilities, Spooner Municipal Utilities, Superior Water Light and Power Co., Wisconsin Dells Municipal Electric Utility, Wisconsin Electric Power Company (We Energies), Wisconsin Power and Light (Alliant), Wisconsin Public Service Corporation, and WPPI Energy.

- Maximum measure installation date
- Total *ex ante* gas therms savings
- Total *ex ante* electric kWh savings
- Minimum other Focus on Energy measure installation date
- Maximum other Focus on Energy measure installation date
- Total other Focus on Energy participation therms *ex ante* savings
- Total other Focus on Energy participation kWh *ex ante* savings
- Other thermostat-related information, such as make and type of thermostat installed, place of purchase, and number of thermostats installed.

The evaluation team then combined the customer-level tracking information with the electric and natural gas billing data by SPECTRUM ID and followed the steps below to conduct each billing analysis:

1. Checked each participant account against SPECTRUM tracking data for participation in other programs during the analysis period
2. Obtained daily average temperature weather data from December 2018 through December 2022 for 30 National Oceanic and Atmospheric Administration (NOAA) weather stations, representing all zip codes associated with the participants
3. Used daily average temperatures to determine base 45°F through base 85°F heating degree days (HDDs) and cooling degree days (CDDs) for each station
4. Obtained typical meteorological year 3 (TMY3; 1991–2005) annual normal and cooling degree days to weather-normalize the billing data
5. Matched billing data periods with the CDDs and HDDs from the associated stations

The participant pre-installation period was one year before the first measure installation and the post-installation period was the one year after the measure installation. The evaluation team used the PRInceton Scorekeeping Method (PRISM) to develop savings estimate models because these models were easier to summarize across various groups.

Data Screening

The evaluation team removed these items from the analyses:

- Billing data readings that spanned less than 15 days or more than 65 days
- Electric billing data monthly readings where use was less than 1 kWh per day
- Participant customers with fewer than 10 pre- and 10 post-installation months

This ensured that the pre- and post-installation periods were well balanced and that all seasons were represented in the PRISM models.

PRISM Modeling Approach

In the next step of the screening process, the evaluation team estimated PRISM models for pre- and post-installation billing data. These models provided weather-normalized pre- and post-installation annual use for each account.

The PRISM electric model used the following specification:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \beta_2 AVGCDD_{it} + \varepsilon_{it}$$

Where for each customer i and month t:

ADC_{it}	=	Average daily kWh consumption in the pre-/post-installation period
α_i	=	Participant intercept; represents the average daily kWh base load
β_1	=	Model space heating parameter value
β_2	=	Model cooling parameter value
$AVGHDD_{it}$	=	Base 45°F-65°F average daily HDDs for the specific location
$AVGCDD_{it}$	=	Base 65°F-85°F average daily CDDs for the specific location
ε_{it}	=	Error term

Using this model, the evaluation team computed weather-normalized annual consumption (NAC) for each heating and cooling reference temperature, as follows:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i + \beta_2 LRCDD_i + \varepsilon_i$$

Where for each customer 'i':

NAC_i	=	Normalized annual kWh consumption
α_i	=	Intercept is the average daily or base load for each participant; it represents the average daily base load from the model
$\alpha_i * 365$	=	Annual base load kWh usage (non-weather-sensitive)
β_1	=	Heating parameter value; in effect, this is usage per HDD from the model above
$LRHDD_i$	=	Annual, long-run HDDs of a typical meteorological year (TMY3) in the 19912005 series from NOAA, based on the home location
$\beta_1 * LRHDD_i$	=	Weather-normalized annual weather-sensitive heating usage, also known as HEATNAC
β_2	=	Cooling parameter value; in effect, this is usage per CDD from the model above
$LRCDD_i$	=	Annual, long-run CDDs of a typical meteorological year (TMY3) in the 19912005 series from NOAA, based on home location

$\beta_2 * LRCDD_i$ = Weather-normalized annual weather-sensitive cooling usage, also known as COOLNAC

ε_i = Error term

Furthermore, if the heating and cooling models above yielded negative intercepts, negative heating parameters, or negative cooling parameters, the evaluation team estimated additional models that included only the cooling usage (cooling-only models) or the heating usage (heating-only models). From these models with correct signs on all of the parameters, the best model chosen for each participant for the pre- and post-installation periods was the model that had the highest R-square.

The PRISM natural gas models used the following specification:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \varepsilon_{it}$$

Where for each customer 'i' and month 't':

ADC_{it} = Average daily therms consumption in the pre- and post-program period

α_i = Participant intercept; represents the average daily therms base load

β_1 = Model space heating parameter value

$AVGHDD_{it}$ = Base 45°F -65°F average daily HDDs for the specific location

ε_{it} = Error term

Using this model, the team computed NAC for each heating and cooling reference temperature, as follows:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i + \varepsilon_i$$

Where for each customer 'i':

NAC_i = Normalized annual therms consumption

α_i = Intercept is the average daily or base load for each participant; it represents the average daily base load from the model

$\alpha_i * 365$ = Annual base load therms usage (non-weather sensitive)

β_1 = Heating parameter value; in effect, this is usage per HDD from the model above

$LRHDD_i$ = Annual, long-run HDDs of a typical month year (TMY3) in the 1991-2005 series from NOAA, based on the home location

$\beta_1 * LRHDD_i$ = Weather-normalized annual weather-sensitive heating usage, also known as HEATNAC

ε_i = Error term

Once the pre- and post-installation uses were obtained for each customer, the evaluation team applied other PRISM-based screening steps and excluded these items:

- Accounts where the post-installation weather-normalized (POSTNAC) use was 70% higher or lower than the pre-installation weather-normalized (PRENAC) use. Such large changes could indicate property vacancies when adding or removing other electric equipment that are unrelated to the smart thermostats.
- Accounts that had missing PRENAC or POSTNAC estimates (because of negative heating and cooling slopes or negative intercepts) because they probably indicated problems with the billing data
- Accounts that received additional measures through other programs in the analysis period
- Electric accounts where PRENAC or POSTNAC was less than 500 kWh or more than 80,000 kWh
- Natural gas accounts where PRENAC or POSTNAC was less than 150 therms
- Accounts that received multiple thermostat types: furnace + heat pump, furnace + boiler, etc.

Finally, the evaluation team performed billing data screens that examined the natural gas and electric monthly billing data for one customer at a time and plotted average monthly use. To avoid confounding the billing analyses, the team removed accounts with outliers, vacancies, seasonal use, and equipment changes in the pre- or post-installation periods.

Smart Thermostat Data Screening Results

Table F-9 summarizes the attrition for smart thermostat natural gas account participants from the various screens. The data showed that 18,629 natural gas service participants received a smart thermostat from January 2020 through September 2021. The team removed approximately 64% of participants due to the utilities' inability to match the requested thermostat accounts. [11] Another 11% were removed due to insufficient pre- or post-period billing data.[12] The team removed another 2% from PRISM screening because of a large percentage change in the use and participation in other programs during the analysis period. Finally, the team removed 1% of participants from individual billing review. The final natural gas analysis group included 4,277 participants.

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[11] Tracking data did not include account numbers for all participants. For those without account numbers, utilities attempted to match the thermostat participants by address. This proved to be too labor intensive for the largest utilities that had higher volumes of participants missing account numbers; hence, they provided billing data only for the participants with valid matching account numbers.

[12] The evaluation team included only data for participating customers in the analysis. If a customer moved during the analysis period, the team removed that customer from the analysis.

Table F-9. Smart Thermostat Natural Gas Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Requested Natural Gas Accounts	**18,629**	**100%**	**0**	**0%**
Matched to billing data provided	6,758	36%	11,871	64%
Less than 10 months of pre- or post-period billing data	4,801	26%	1,957	11%
Usage/percentage change screens + PRISM screening	4,687	25%	114	1%
Individual customer bill review: outliers, vacancies, seasonal usage, and equipment changes	4,436	24%	251	1%
Participated in other programs during analysis period	4,382	24%	54	0%
Installed thermostats for heat pumps (only furnaces and boilers kept)	4,287	23%	95	1%
Multiple thermostat equipment types installed	4,277	23%	10	0%
Final Analysis Group	**4,277**	**23%**	**14,352**	**77%**

Table F-10 summarizes the attrition for smart thermostat electric account participants from the various screens. The data showed that 19,416 electric service participants received a smart thermostat from January 2020 through September 2021. The team removed approximately 55% of participants due to utilities' inability to match the requested thermostat accounts and another 13% of participants due to insufficient pre- or post-period billing data. [13,14] The team also removed 6% of participants from individual billing review and 2% from PRISM screening because of large percentage changes in usage and participation in other programs during the analysis period. The final electric analysis group included 4,703 participants.

Table F-10. Smart Thermostat Electric Participant Account Attrition

Screen	Participants Remaining	Percentage Remaining	Number Dropped	Percentage Dropped
Original Electric Accounts	**19,416**	**100%**	**0**	**0%**
Matched to billing data provided	8,648	45%	10,768	55%
Less than 10 months of pre- or post-period billing data	6,220	32%	2,428	13%
Usage/percentage change screens + PRISM screening	5,983	31%	237	1%
Individual customer bill review: outliers, vacancies, seasonal usage, and equipment changes	4,817	25%	1,166	6%
Participated in other programs during analysis period	4,715	24%	102	1%
Multiple thermostat equipment types installed	4,703	24%	12	0%
Final Analysis Group	**4,703**	**24%**	**14,701**	**76%**

13 Tracking data did not include account numbers for all participants. For those without account numbers, utilities attempted to match the thermostat participants by address. This proved to be too labor intensive for the largest utilities that had higher volumes of participants missing account numbers; hence, they provided billing data only for the participants with valid matching account numbers.

14 The evaluation team included only data for participating customers in the analysis. If a customer moved during the analysis period, the team removed that customer from the analysis.

Following these screens, the smart thermostat natural gas analysis group included 4,277 participants (23% of the original total) and the electric analysis group included 4,703 participants (24% of the original total).

Smart Thermostat Billing Analysis Results

Table F-11 lists the savings, realization rates, and precision achieved for each analysis.

Table F-11. Smart Thermostats Gross Billing Analysis Results

Savings Type	Equipment Type	Savings End Use	Savings (kWh/Therms)	Precision at 90% Confidence
Electricity	Furnace	Cooling	260	6%
Electricity	Boiler	Cooling	196	46%
Electricity	Heat Pump	Cooling	264	30%
Electricity	Furnace	Heating	207	12%
Electricity	Boiler	Heating	0	N/A
Electricity	Heat Pump	Heating	509	31%
Natural Gas	Furnace	Heating	30	7%
Natural Gas	Boiler	Heating	53	35%
Natural Gas	Heat Pump	Heating	0	N/A

The evaluation team used PRISM models to estimate savings, realization rates, and standard errors. Table F-12, Table F-13, and Table F-14 summarize the savings, precision, and other key values for the electric cooling analysis, the electric heating analysis, and the natural gas heating analysis, respectively. The PRENAC values reported in each table are the assumed pre-installation weather-normalized energy consumption values. The reported precision values are the relative precision of the savings, meaning the higher the precision the larger the error bound. Larger sample sizes will lead to higher precision and smaller error bounds. Due to fewer participants with boiler or heat pump systems, the boiler and heat pump systems' savings estimates are less precise than the overall ±6% precision at the 90% confidence level. However, the average savings estimates are still a good representation of the savings based on actual Focus on Energy participants.

Table F-12. CY 2022 Smart Thermostat Verified Gross Electric Cooling Savings

Evaluation Year	Group	Participant Count	Cooling Model Savings (kWh)	Precision at 90% Level	Cooling PRENAC (kWh)	% Savings
2017[a]	**All**	**2,110**	**325**	**8%**	**1,587**	**20.7%**
2022	All	4,703	258	6%	1,612	16.0%
2022	Furnace	4,127	260	6%	1,616	16.1%
2022	Boiler	159	196	46%	1,729	11.3%
2022	Heat Pump	254	264	30%	1,476	17.9%

[a] This table includes the CY 2016 billing analysis results because they informed the TRM *ex ante* energy savings used in the CY 2022 evaluation.

On average, smart thermostat participants saved 258 kWh in electric cooling. With average pre-installation period cooling usage of 1,612 kWh, the gross savings represent a 16% reduction in cooling usage. The overall relative precision at the 90% confidence level is ±6%.

Table F-13. CY 2022 Smart Thermostat Verified Gross Electric Heating Savings

Evaluation Year	Group	Participant Count	Heating Model Savings (kWh)	Precision at 90% Level	Heating PRENAC (kWh)	% Savings
2017	**All**	**2,110**	**115**	**24%**	**810**	**14.2%**
2022	All	4,544	224	7%	1,362	16.5%
2022	Furnace	4,290	207	12%	1,204	17.2%
2022	Heat Pump	254	509	31%	4,030	12.6%

On average, smart thermostat participants saved 224 kWh in electric heating. With average pre-installation period heating usage of 1,362 kWh, the gross savings represent a 16.5% reduction in heating usage. The overall relative precision at the 90% confidence level is ±7%.

Table F-14. CY 2022 Smart Thermostat Verified Gross Gas Heating Savings

Evaluation Year	Group	Participant Count	Heating Model Savings (therms)	Precision at 90% Level	Heating PRENAC (Therms)	% Savings
2017	**All**	**2,427**	**31**	**9%**	**670**	**4.6%**
2022	All	4,277	32	8%	706	4.5%
2022	Furnace	4,127	32	7%	692	4.6%
2022	Boiler	150	43	35%	1,087	3.9%

On average, smart thermostat participants saved 32 therms in natural gas heating. With average pre-installation period heating usage of 706 therms, the gross savings represent a 4.5% reduction in natural gas heating usage. The overall relative precision at the 90% confidence level is ±8%.

Save to Give Billing Analysis

For the Save to Give Pilot, the evaluation team used panel regression models to analyze the effects of Save of Give treatment on energy consumption. The analyses conformed to the approach described in the Uniform Methods Project.[15] The team used both post-only models and difference-in-differences

15 Stewart, Jim, and A. Todd. 2020. *The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures*. "Chapter 17: Residential Behavior Evaluation Protocol." Prepared for National Renewable Energy Laboratory, Golden, Colorado. NREL/SR-7A40-77435. https://www.nrel.gov/docs/fy21osti/77435.pdf

models and tested different regression model specifications.[16] The models controlled for pre-Save to Give energy consumption patterns, customer-specific fixed effects (average consumption for each unique customer ID), time fixed effects (average consumption for each calendar month), and weather effects (HDDs and CDDs calculated at 65°F base temperature). The team clustered standard errors on each pair of participants and matched nonparticipants. Consistent with the matching, the team estimated separate models for Lodi and Bayfield County customers and for electric customers and natural gas customers.

The evaluation team estimated the percentage of unadjusted net savings,[17] which are the ratio of average daily savings per each Lodi or Bayfield County Save to Give participant to the control group's nonparticipant's average daily consumption in the post-participation period. These savings serve as an estimate of the baseline energy use absent the pilot.

The team also estimated annual unadjusted net savings as the product of average daily savings per participant and the total number of days all participants were treated, referred to as treatment days. If a customer was active for the whole year (a full year starting from the start date of Campaign 1), the number of treatment days was 365. If a customer was inactive for part of the year, the number of treatment days was the number of days from the start date of Campaign 1 to the final active day in the dataset (less than or equal to 365 days).[18]

Lodi

The evaluation team analyzed both electric and natural gas billing data for Lodi.

Matching for Electric Customers

In the propensity scores matching, the team used a Logit model to estimate propensity scores that include pre-treatment period summer average daily energy consumption (ADC) as the covariate.[19] To assess the quality of the resulting matches, the team examined the covariate balance after matching

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16 Post-only model regresses each customer's average daily energy consumption (in a given month) on a treatment indicator variable and other control variables. The control variables (regressors) include the customer's pre-treatment energy use by month, month-by-year fixed effects, and weather. Allcott, Hunt, and Todd Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review* (104, no. 10): 3003–3037.

17 The evaluation team did not adjust net savings by uplift savings, which occur when treatment customers participate in other Focus on Energy residential energy efficiency offerings at a higher rate than control group customers.

18 If the number of days from the start date of Campaign 1 to the final active day in the dataset is greater than 365, the team used 365 treatment days.

19 The evaluation team also tested to include winter average daily energy consumption (ADC), shoulder ADC, and total average ADC, and each of the 12 months ADC in the pre-treatment periods in the estimation of propensity scores. The team chose the model that results in best fitness of model (lowest Akaike information criterion [AIC]) and matching balance.

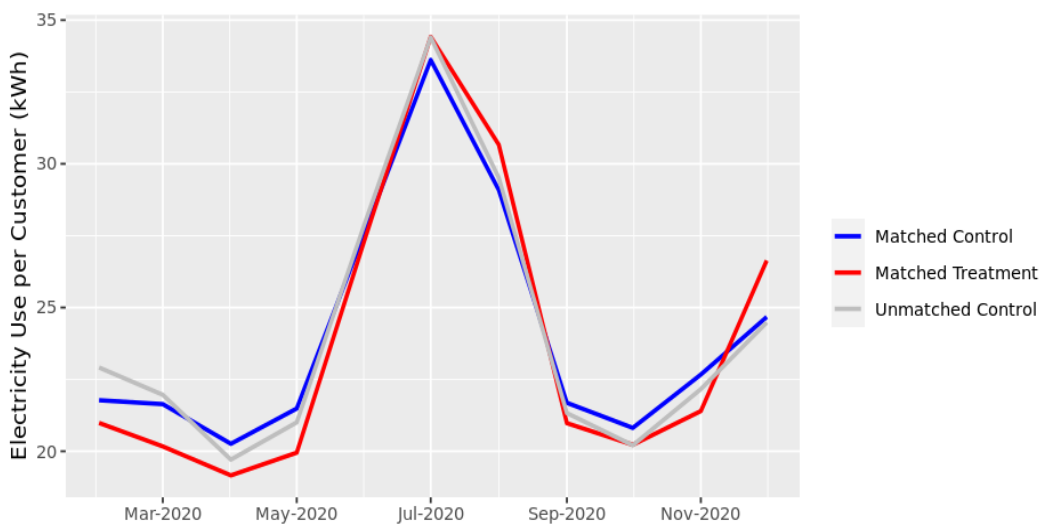
(Table F-15).[20] Standardized mean differences are close to zero and variance ratios are close to 1, indicating good balance. Based on a two-sample t-test, the mean of pre-treatment period summer ADC in the treatment group is not statistically different from the mean of pre-treatment period summer ADC in the control group.

Table F-15. Summary of Balance after Matching for Lodi Electric Customers

	Means Treated	Means Control	Std. Mean Differences	Variance Ratio	Pair Distances
Distance	0.051	0.051	0.000	1.001	0.000
Pre-period Summer ADC	28.182	28.183	0.000	1.001	0.001

The team also conducted visual diagnostics to look for differences between the groups. Figure F-1 shows the monthly electric ADC in the pre-treatment period by matching groups. The treatment group's pre-treatment period ADC is better matched to the control group's pre-treatment period ADC during summer months.

Figure F-1. Pre-Treatment Period Average Daily Electricity Consumption in Lodi



Billing Analysis for Electric Customers

The evaluation team found the treatment effect of the Save to Give Challenge on electricity consumption was consistently negative across different model specifications, meaning participant consumption was lower in the treatment group than in the control group. Though the consistent results indicated electricity savings from the pilot, treatment effects were not statistically significant. Table F-16 shows the regression results of the post-only model, which typically have higher precision and are more

20 Assessing balance involves assessing whether the distributions of covariates are similar between the treated and control groups. Balance is typically assessed by examining univariate balance summary statistics for each covariate. Greifer, N. 2021. *Assessing balance*. The R foundation. https://cran.r-project.org/web/packages/MatchIt/vignettes/assessing-balance.html

robust.[21] The treatment effect was -0.517, that is, average daily savings per customer is 0.517 kWh, or 517 watt hours per day. Using the savings calculation formula referenced in the methodology section, this represents a net percentage savings of approximately 2.2% and total annual savings of 21,917 kWh across all Lodi participants.[22]

Table F-16. Estimation of the Treatment Effects for Electric Customers in Lodi (Standard Errors in Parentheses)

	Post-Only Model
Treatment Effect on Electricity Consumption	**-0.517**
(Standard Error)	(0.551)
Heating Days (HDD 65)	0.268*
(Standard Error)	(0.148)
Cooling Days (CDD 65)	1.490*
(Standard Error)	(0.814)
Month Fixed Effects × Monthly Pre-Period ADC	Yes
Month Fixed Effects	Yes
Observations	3,326
R^2	0.768
Adjusted R^2	0.766
Residual Standard Error	6.845 (df = 3301)

Note: This table reports estimates of the treatment effect of the Save to Give Pilot and the effects of other covariables on energy consumption.
A "*" is placed next to estimate to indicate *p*-value (statistical significance level):
*p<0.1; **p<0.05; ***p<0.01.
Cluster-robust standard errors are in parentheses.

Matching for Natural Gas Customers

In the propensity scores matching, the team used a Logit model to estimate propensity scores that include pre-treatment period winter ADC as the covariate.[23] To assess the quality of the resulting matches, the team examined the covariate balance after matching (Table F-17). Standardized mean differences are close to zero and variance ratios are close to 1, indicating good balance. Based on a two-sample t-test, the mean of pre-treatment period winter ADC in the treatment group was not statistically different from the mean of pre-treatment period winter ADC in the control group.

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21 Allcott, Hunt, and Todd Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review* (104, no. 10): 3003–3037.

22 The post control group ADC is 23.58 kWh and the total number of treatment days is 42,393.

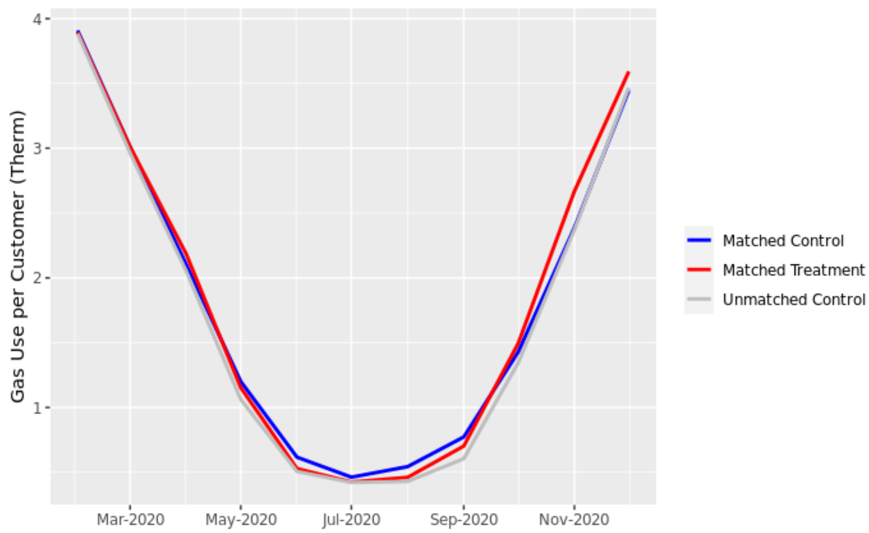
23 The evaluation team also tested to include summer ADC, shoulder ADC, and total average ADC, and each of the 12 months ADC in the pre-treatment periods in the estimation of propensity scores. The team chose the model that results in best fitness of model (lowest AIC) and matching balance.

Table F-17. Summary of Balance after Matching for Lodi Natural Gas Customers

	Means Treated	Means Control	Std. Mean Differences	Variance Ratio	Pair Distances
Distance	0.015	0.015	0.000	0.998	0.001
Pre-Period Winter ADC	3.435	3.435	0.000	0.998	0.001

In addition, the team conducted visual diagnostics to look for differences between the groups. Figure F-2 shows the monthly natural gas ADC in the pre-treatment period by matching groups. The treatment group's pre-treatment period ADC was better matched to the control group's pre-treatment period ADC during winter months.

Figure F-2. Pre-Treatment Period Average Daily Natural Gas Consumption in Lodi



Billing Analysis for Natural Gas Customers

The evaluation team found the treatment effect of the Save to Give Challenge on natural gas consumption was positive, meaning participants' consumption was higher in the treatment group than in the control group and there were no energy savings. Table F-18 shows the regression results of the post-only model. The treatment effect is 0.064, that is, average daily savings per customer is -0.064 therm. This represents a net percentage savings of approximately -2.9% and total annual savings of -604 therms across all Lodi participants.[24] However, the treatment effects and savings were not statistically significant, and the results were not consistent across models.

[24] The post control group ADC is 2.21 therms and the total number of treatment days are 9,441.

Table F-18. Estimation of the Treatment Effects for Natural Gas Customers in Lodi

	Post-Only Model
Treatment Effect on Natural Gas Consumption	**0.064**
(Standard Error)	(0.041)
Heating Days (HDD 65)	0.075
(Standard Error)	(0.048)
Cooling Days (CDD 65)	0.051*
(Standard Error)	(0.029)
Month Fixed Effects × Monthly Pre-Period ADC	Yes
Month Fixed Effects	Yes
Observations	677
R^2	0.966
Adjusted R^2	0.964
Residual Standard Error	0.332

Note: This table reports estimates of the treatment effect of the Save to Give Pilot and the effects of other covariables on energy consumption.
A "*" is placed next to estimate to indicate *p*-value (statistical significance level): *p<0.1; **p<0.05; ***p<0.01.
Cluster-robust standard errors are in parentheses.

Bayfield County

The evaluation team analyzed both electric and natural gas billing data for Bayfield County.

Matching for Electric Customers

In the propensity scores matching, the team used a Logit model to estimate propensity scores that include monthly ADC in the pre-treatment period as the covariate.[25] Table F-19 shows the covariates balance after matching. Most of the standardized mean differences are close to zero (absolute values are less than 0.1) and variance ratios are close to 1, indicating good balance in general. Based on a two-sample t-test, the mean of pre-period monthly ADC in the treatment group was not statistically different from the mean of the corresponding pre-period monthly ADC in the control group.

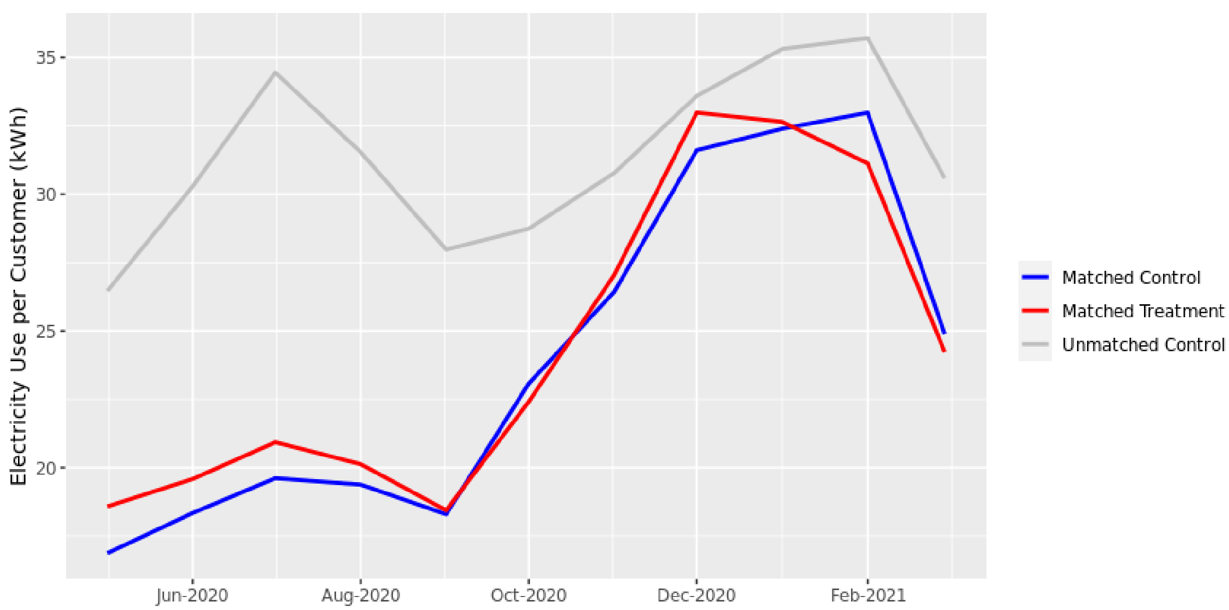
[25] The evaluation team also tested to include winter ADC, summer ADC, shoulder ADC, and total average ADC in the pre-treatment periods in the estimation of propensity scores. The team also conducted Mahalanobis distance matching. The final model was the one with best fitness of model (lowest AIC) and matching balance.

Table F-19. Summary of Balance after Matching for Bayfield Electric Customers

	Means Treated	Means Control	Standard Mean Difference	Variance Ratio	Pair Distance
Distance	0.006	0.006	-0.001	0.995	0.001
Pre-period Jan. ADC	33.627	31.958	0.047	0.786	0.704
Pre-period Feb. ADC	32.171	32.538	-0.010	0.679	0.742
Pre-period Mar. ADC	25.105	24.550	0.022	0.680	0.770
Pre-period May. ADC	18.577	16.659	0.133	0.866	0.969
Pre-period Jun. ADC	19.584	18.261	0.091	1.455	0.819
Pre-period Jul. ADC	20.928	19.530	0.088	1.396	0.701
Pre-period Aug. ADC	20.186	19.272	0.062	1.232	0.769
Pre-period Sep. ADC	18.586	18.151	0.035	0.939	0.876
Pre-period Oct. ADC	22.354	22.777	-0.023	0.662	0.875
Pre-period Nov. ADC	27.009	26.069	0.037	0.776	0.768
Pre-period Dec. ADC	33.075	31.182	0.061	0.748	0.685

Visually, the treatment group's pre-treatment period ADC was better matched to the control group's pre-treatment period ADC from September to November 2020 (Figure F-3). Compared with the unmatched control group customers, the matched control group customers' pre-treatment period energy consumption patterns were more similar to those of the treated customers.

Figure F-3. Pre-Treatment Period Average Daily Electricity Consumption in Bayfield



Billing Analysis for Electric Customers

The team found the treatment effect of the Save to Give Challenge on electricity consumption was consistently negative across different model specifications, again suggesting lower consumption in the treatment group. Though the consistent results indicated electricity savings from the pilot, the treatment effects were not statistically significant.

Table F-20 shows the regression results of the post-only model. The treatment effect was -0.645, or an average daily savings per customer of 0.645 kWh, or 645 watt hours per day. Based on the savings calculation formula referenced in the methodology section, the net percentage savings were approximately 2.7% and total annual savings were 17,421 kWh across all Bayfield County participants.[26]

Table F-20. Estimation of the Treatment Effects for Electric Customers in Bayfield

	Post-Only Model
Treatment Effect on Electricity Consumption	**-0.645**
(Standard Error)	(1.272)
Heating Days (HDD 65)	0.177
(Standard Error)	(0.222)
Cooling Days (CDD 65)	0.761
(Standard Error)	(0.556)
Month Fixed Effects × Monthly Pre-Period ADC	Yes
Month Fixed Effects	Yes
Observations	1,566
R^2	0.817
Adjusted R^2	0.814
Residual Standard Error	11.306 (df = 1540)

Note: This table reports estimates of the treatment effect of the Save to Give Pilot and the effects of other covariables on energy consumption.
A "*" is placed next to estimate to indicate *p*-value (statistical significance level): $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.
Cluster-robust standard errors are in parentheses.

Matching for Natural Gas Customers

Like propensity score matching for electric customers, the evaluation team used a Logit model to estimate propensity scores for natural gas customers that include monthly ADC in the pre-treatment period as the covariate.[27] Table F-21 shows the covariates balance after matching. Most of the standardized mean differences were close to zero (absolute values are around 0.1) and variance ratios were close to 1, indicating good balance in general. Based on a two-sample t-test, the mean of pre-period monthly ADC in the treatment group was not statistically differently from the mean of pre-period monthly ADC in the control group.

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26 The post control group ADC is 23.51 kWh and the total number of treatment days is 27,010.

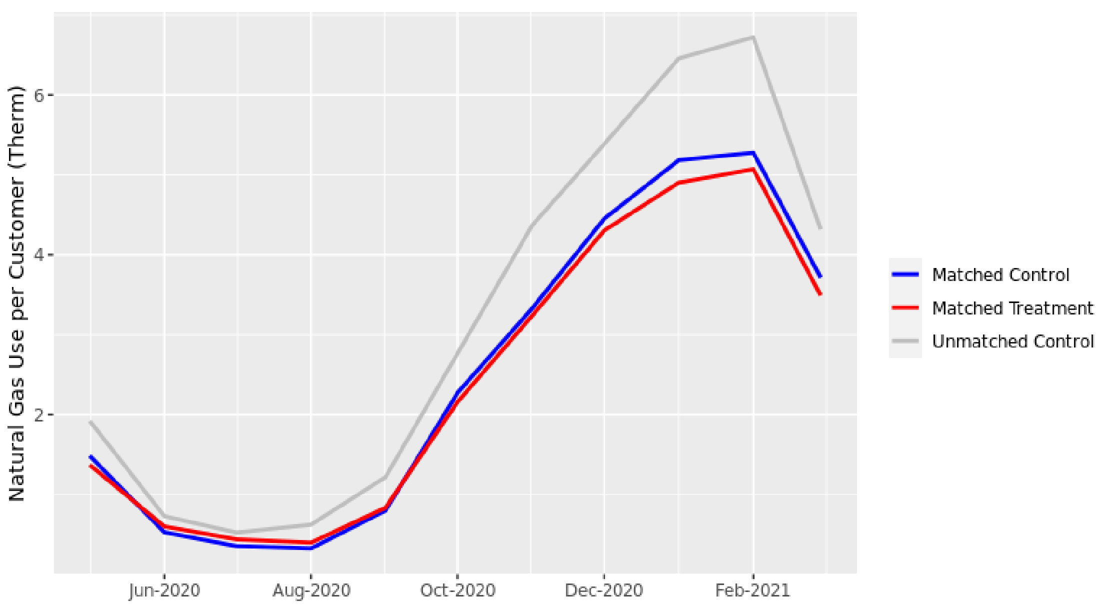
27 The Cadmus team also tested to include winter ADC, summer ADC, shoulder ADC, and total average ADC in the pre-treatment periods in the estimation of propensity scores. Additionally, the team conducted Mahalanobis distance matching. The final model is the one that resulted in best fitness of model (lowest AIC) and matching balance.

Table F-21. Summary of Balance after Matching for Bayfield Natural Gas Customers

	Means Treated	Means Control	Std. Mean Difference	Var. Ratio	Pair Distances
Distance	0.033	0.020	0.096	7.276	0.096
Pre-period Jan. ADC	4.887	5.245	-0.161	0.302	1.261
Pre-period Feb. ADC	5.057	5.347	-0.122	0.402	1.127
Pre-period Mar. ADC	3.449	3.739	-0.170	0.236	1.443
Pre-period May. ADC	1.370	1.499	-0.192	0.262	1.491
Pre-period Jun. ADC	0.602	0.554	0.110	0.779	0.975
Pre-period Jul. ADC	0.441	0.363	0.125	1.284	0.664
Pre-period Aug. ADC	0.392	0.338	0.163	0.959	1.170
Pre-period Sep. ADC	0.836	0.815	0.040	0.525	1.271
Pre-period Oct. ADC	2.155	2.293	-0.137	0.227	1.548
Pre-period Nov. ADC	3.230	3.366	-0.091	0.328	1.266
Pre-period Dec. ADC	4.287	4.498	-0.108	0.270	1.328

Visually, the treatment group's average pre-treatment period ADC was better matched to the control group's pre-treatment period ADC from May to December 2020 (Figure F-4). Compared with the unmatched control group customers, the matched control group customers' pre-treatment period energy consumption patterns were more similar to those of the treated customers.

Figure F-4. Pre-Treatment Period Average Daily Natural Gas Consumption in Bayfield



Billing Analysis for Natural Gas Customers

The evaluation team found the treatment effect of the Save to Give Challenge on natural gas consumption was consistently negative across different model specifications. Though consistent results indicated natural gas savings from the pilot, the treatment effects were not statistically significant. The treatment effect on natural gas consumption of -0.049 was smaller in magnitude than the treatment effect on electricity (Table F-22). The net percentage savings were 1.8% and total annual savings were 787 therms across all Bayfield County participants.

Table F-22. Estimation of the Treatment Effects for Natural Gas Customers in Bayfield

	Post-Only Model
Treatment Effect on Gas Consumption	**-0.049**
(Standard Error)	(0.062)
Heating Days (HDD 65)	0.022*
(Standard Error)	(0.013)
Cooling Days (CDD 65)	-0.030
(Standard Error)	(0.028)
Month Fixed Effects × Monthly Pre-Period ADC	Yes
Month Fixed Effects	Yes
Observations	942
R^2	0.969
Adjusted R^2	0.968
Residual Standard Error	0.558 (df = 916)

Note: This table reports estimates of the treatment effect of the Save to Give Pilot and the effects of other covariables on energy consumption.
A "*" is placed next to estimate to indicate *p*-value (statistical significance level): *p<0.1; **p<0.05; ***p<0.01.
Cluster-robust standard errors are in parentheses.

Multifamily Strategic Energy Management Pilot Analysis

This section includes the energy model and engineering calculation verification details for the Multifamily Strategic Energy Management (SEM) Pilot.

Energy Model Verification Details

The evaluation team reviewed the energy models for the Multifamily SEM Pilot in the implementer's report for coverage, interpretability, and goodness-of-fit. The team also assessed the models for any trends in variance evident in the model residuals.

Model Coverage

Table F-23 and Table F-24 show the findings for good model coverage and sensical interpretability of the coefficient estimates. The evaluation team determined that major energy drivers, such as weather and occupancy variables, were included in the models and controlled for changes in energy consumption as expected.

Table F-23. Model Coverage and Interpretability for Participant 1

Criteria		Finding	Reasoning
Major energy drivers are included in the final baseline regression model.		Not verified	Model includes weather variables only and does not include the holiday or university breaks indicator.
Coefficients are significantly different from 0 at 5% significance level (p-value > 0.05).		Verified	The coefficients of all variables are significantly different from 0 with p-value less than 0.05.
Coefficient estimates are sensical	Weather	Verified	HDDs and CDDs have statistically significant and positive effects on energy consumption.
	Holiday/shutdown	Not verified	Model does not include holiday or university breaks indicator, which could be a major factor influencing energy usage in the university apartments.
	Other	N/A	No other variables included in the model.
Overall		**Verified**	**All coefficients of variables included are statistically significant, though the coefficient estimates could be biased due to missing variables.**

Table F-24. Model Coverage and Interpretability for Participant 2 (Site for Commercial Savings)

Criteria		Finding	Reasoning
Major energy drivers are included in the final baseline regression model.		Verified	Model includes weather variable and indicators of shutdown variables.
Coefficients are significantly different from 0 at the 5% significance level (p-value > 0.05).		Verified	The coefficients of all variables are significantly different from 0 with p-value less than 0.05.
Coefficient estimates are sensical	Weather	Verified	HDDs have a statistically significant and positive effect on energy consumption.
	Holiday/shutdown	Verified	Model includes the shutdown indicator.
	Other	N/A	No other variables included in the model.
Overall		**Verified**	**Major energy drivers are included in the model and all the coefficients of variables included are statistically significant.**

Goodness-of-Fit

The evaluation team verified whether the energy intensity model met the goodness-of-fit criteria for Participant 1 and Participant 2, shown in Table F-25 and Table F-26 respectively. The team verified that the energy intensity model passed all criteria.

Table F-25. Goodness-of-Fit Criteria for Participant 1

Criteria	Model	Finding	Reasoning
Adjusted R-squared value > 0.75	0.89	Verified	Passed
Net Determination Bias < 0.005%	0.00	Verified	Passed
Coefficient of Variance < 5%	4.80%	Verified	Passed
Autocorrelation Coefficient < |0.5|	0.49	Verified	Passed
Overall		**Verified**	**Passed major goodness-of-fit criteria**

Table F-26. Goodness-of-Fit Criteria for Participant 2 (Site for Commercial Savings)

Criteria	Model	Finding	Reasoning
Adjusted R-squared value > 0.75	0.92	Verified	Passed
Net Determination Bias < 0.005%	0.00	Verified	Passed
Coefficient of Variance < 5%	2.70%	Verified	Passed
Autocorrelation Coefficient < |0.5|	-0.17	Verified	Passed
Overall		**Verified**	**Passed major goodness-of-fit criteria**

Residual Diagnostics

Table F-27 and Table F-28 show the results of the evaluation team's residual diagnostics review for Participant 1 and Participant 2. Based on the plots of residuals over time and residuals against predicted consumption,[28] the team determined that there was no evidence of nonconstant variance trends or poor model fit.

Table F-27. Residual Diagnostics for Participant 1

Criteria		Finding	Reasoning
Residuals Against Fitted Values	Curvature	Verified	The residuals bounce randomly around the 0 line, suggesting the assumption of the linearity is reasonable.
	Heteroskedasticity	Verified	The residuals roughly form a horizontal band around the 0 line, suggesting that the variances of the error terms are equal.
	Systematic over- or underpredictions	Verified	The residuals do not appear to be systematically greater or less than 0 as fitted values increase.
Residuals Over Time	Nonconstant spread	Verified	The residuals fluctuate around 0 consistently across the engagement period.
	Systematic over- or underpredictions	Verified	The residuals do not exhibit systematic standard deviations greater or less than 3 over time.
Outliers	Multiple and influential	Verified	Only one outlier beyond 3 standard deviations, but most are within 3 standard deviations.
Overall		**Verified**	**The residuals are generally well-behaved.**

28 The implementer, CLEAResult, provided the plots of residuals over time. The evaluation team created the plots of residuals against predicted consumption using the data provided in the workbooks.

Table F-28. Residual Diagnostics for Participant 2 (Site for Commercial Savings)

Criteria		Finding	Reasoning
Residuals Against Fitted Values	Curvature	Verified	The residuals bounce randomly around the 0 line, suggesting the assumption of the linearity is reasonable.
	Heteroskedasticity	Verified	The residuals roughly form a horizontal band around the 0 line, suggesting that the variances of the error terms are equal.
	Systematic over- or underpredictions	Verified	The residuals do not appear to be systematically greater or less than 0 as fitted values increase.
Residuals Over Time	Nonconstant spread	Verified	The residuals fluctuate around 0 consistently across the engagement period.
	Systematic over- or underpredictions	Verified	The residuals do not exhibit systematic standard deviations greater or less than 3 over time.
Outliers	Multiple and influential	Verified	Only a few outliers beyond 3 standard deviations, but most are within 3 standard deviations.
Overall		**Verified**	**The residuals are generally well-behaved.**

Engineering Calculation Verification Details

The evaluation team validated that inputs, assumptions, and formulas were accurate for estimating energy savings. However, the team identified an error in calculations for a cold-line insulation opportunity for Participant 3. The heat gained by the line due to poor insulation used a misrepresentative ambient air temperature for each temperature bin. The error and recalculation are shown in Table F-29.

Table F-29. Participant 3 EMC 1 –
Domestic Hot Water Recirculating Pump Variable Frequency Drive

Temperature Bin	Temperature Used	
	Original Calculation	Evaluation Recalculation
90°F – 95°F	95°F	92.5°F
85°F – 90°F	90°F	87.5°F
80°F – 85°F	85°F	82.5°F
75°F – 80°F	80°F	77.5°F
70°F – 75°F	75°F	72.5°F

Nonresidential Solutions: Project Details from Sampled Projects

The evaluation team performed desk reviews and on-site verification reviews of a sample of projects in each nonresidential solution: Business and Industry, Schools and Government, and New Construction. The team calculated measure-level realization rates based on the analysis completed for these sample projects, which informed the offering- and solution-level realization rates for CY 2022. A more detailed description of the sampled projects follows.

Large Industrial Offering (Business and Industry Solution)

The evaluation team found several discrepancies in realization rates for sampled projects in the CY 2022 Large Industrial Offering. In the impact sample, 47 of 60 projects achieved a 100% energy realization rate. Of those with discrepancies, four projects deviated significantly, defined as more than 20% above or below a 100% realization rate. One project had a realization rate of 175% (greater than 120%), and three projects had realization rates of 0% (less than 80%).

Table F-30 includes additional details about projects with discrepancies. The table designates projects using their master measure identifier (MMID).

Table F-30. CY 2022 Large Industrial Offering Sample Detailed Projects

MMID	Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
2421	Industrial Oven or Furnace, Not Otherwise Specified	155,687	-	0%	2%	The evaluation team collected almost four years of natural gas consumption data for the furnaces from January 2019 to November 2022. This provided over three years for pre-measure installation data and about seven months of post-measure installation data for analysis. The team was also able to get production data for the facility and weather data from a nearby weather station for the same timeframe. The team conducted a weather dependent regression analysis that showed no correlation with natural gas consumption of the furnaces, which was expected considering the measure is a process-related furnace. The team then compared the pre and post natural gas consumption using production normalized regression, which showed a high correlation (R-value of 0.7), and could confirm that natural gas consumption and kWh boost increased per ton of production. The team analyzed multiple years of production, fuel, and oxygen data drawing a production normalized regression. The natural gas consumption increased for all scenarios. After normalizing for production, the team concluded that actual natural gas savings were negative at -226,080.84 therms per year. Conversations with the site contact gave no indications of changes in the production process or setpoints of the furnaces and the team is unsure of the cause of the resulting increase in natural gas usage. The original analysis used a Cleaver Brooks marketing document to claim an efficiency increase associated with O2 percentage. Considering there is available production and natural gas usage data, the team recommends the approach summarized above to calculate savings.
2499	Process, Not Otherwise Specified	147,916	154,665	105%	1%	Actual motor efficiency was not factored into the *ex ante* savings calculation. *Ex post* has assumed 95% motor efficiency, which when applied to the calculation, results in slightly higher savings and a realization rate of 105%. The team interviewed the customer to determine reasonable motor efficiency for this application.
2382	HVAC Controls, Scheduling/ Setpoint Optimization	5,744	7,865	137%	0%	Measure #2 was sampled: reduction of heating setpoints. The *ex post* calculation modified the final heating setpoint from 67 to 70 based on customer feedback, which resulted in reduced savings for this element. The savings calculation was further modified by incorporating more accurate HDD analysis to both the baseline and proposed cases, resulting in greater savings. The second modification outweighs the first; therefore, cumulative modification resulted in greater *ex post* savings.
2648	VFD, Process Pump	3,893	3,828	98%	0%	The slight decrease in savings is due to the *ex post* calculation using actual observed HP (29.5 HP) instead of likely a rounded value (30 HP) used in *ex ante* calculations.
3280	VFD, Constant Torque	1,215	-	0%	0%	Several site contacts indicated that it was less expensive to purchase the equipment that was part of this application with the VFD included, despite not needing reduced speed or flow functionality for their production line. Field technicians viewed all motors (from all measures, not just sampled ones) in the field and via the programmed front end. All were locked out at 60 Hz running 100% 24/7. Trends demonstrate all motors have been locked at this setting for the duration of operation. The customer anticipates no changes to this programming based on their needs. As a result, the evaluation team zeroed out the savings for this project; the energy penalty of the VFD was not accounted for. Only the sampled measures were affected by this change, not all other measures from this project.
3280	VFD, Constant Torque	39	-	0%	0%	Several site contacts indicated that it was less expensive to purchase the equipment that was part of this application with VFD included, despite not needing reduced speed or flow functionality for their production line. Field technicians viewed all motors (from all measures, not just sampled ones) in the field and via the

MMID	Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
						programmed front end. All were locked out at 60 Hz running 100% 24/7. Trends demonstrate all motors have been locked at this setting for the duration of operation. The customer anticipates no changes to this programming based on their needs. As a result, the evaluation team zeroed out the savings for this project; the energy penalty of the VFD was not accounted for. Only the sampled measures were affected by this change, not all other measures from this project.
2264	Compressed Air, Cycling Thermal Mass Air Dryers	1,970	3,453	175%	0%	Given the date of the project *ex post,* the team used the TRM 2022 for this MMID. All inputs aside from cubic feet per minute (cfm) are fixed deemed inputs for this prescriptive measure. Correct cfm appears to be 2,400 based on application entry and specifications. The HOU appeared to be higher than the deemed values, but not adjusted to match the actual. The team used the lower deemed value.
2648	VFD, Process Pump	1,324	1,332	101%	0%	*Ex post* savings were slightly higher than *ex ante* due to the actual observed HP of the units used in *ex post* calculation (10.06 HP) instead of the rounded value used in *ex ante* calculation (10 HP).
285	Ventilation Filtration vs Make Up Air System	378,506	375,443	99%	4%	The team modified hours of use from 7,488 (24/6/52) to 7,072 (24/5.67/52) based on the customer's confirmed operational feedback.
2386	HVAC, Not Otherwise Specified	324,949	300,689	93%	3%	The team modified hours of use from 7,488 (24/6/52) to 7,072 (24/5.67/52) based on the customer's confirmed operational feedback.
2498	Process Heat Recovery, Not Otherwise Specified	201,393	189,743	94%	2%	Data collected from the customer during virtual and on-site visits does not support the *ex ante* savings calculation inputs. The data demonstrated an increase in city water use and that city water use was greater than the feedwater supplied. However, the provided data appeared to have errors. For the *ex post* calculation, the team instead relied on a technical reference to calculate theoretical savings—Crane Technical Paper 410 estimates steam flow through an orifice based on specific parameters. The project-specific parameters suggest slightly less therms savings were achieved than the *ex ante* estimate (94% realization rate).
2648	VFD, Process Pump	2,113	2,514	119%	0%	During the interview, the customer indicated that annual average hours of use were slightly higher than projects for this piece of equipment (8,664 hours up from 7,280). The team used the new value to calculate *ex post* savings, which resulted in slightly higher kWh savings.
2499	Process, Not Otherwise Specified	614,043	604,720	98%	6%	The evaluation team investigated all major inputs and assumptions used to calculate *ex ante* savings. The team reviewed pressure differential data provided by the customer for Dryer 1, Dryer 3, and Dryer 5 for the period from August 2022 to February 2023. The pressure differential data provided additional feedback on periods when the dryers were off and not in use. The team took the average of dryer utilization for all three dryers, which resulted in 81% utilization. This was lower than the originally estimated utilization, which reduced savings. The team also investigated the 25% useful water claim, which appeared to be accurate after speaking with facility staff.

Commercial and Industrial Offering (Business and Industry Solution)

The evaluation team found several discrepancies in realization rates for sampled projects in the CY 2022 Commercial and Industrial Offering. In the impact sample, 91 of 98 projects achieved a 100% energy realization rate. Of those with discrepancies, three projects deviated significantly, defined as more than 20% above or below a 100% realization rate. One project had a realization rate of 180% (greater than 120%), and two projects had realization rates of 74% and 77% (less than 80%).

Table F-31 includes specific details about the projects with discrepancies.

Table F-31. CY 2022 Commercial and Industrial Offering Sample Detailed Projects

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
2498	Process Heat Recovery, Not Otherwise Specified	381,166	445,988	117%	11%	This project involved makeup air design modification to utilize heat recovery. Based on an interview with the customer, the team updated the reported heating hours to reflect current climate data specific to the project region. This resulted in a very slight modification to therms savings. Based on customer feedback, the team used a setpoint of 66°F for the heating season and 72°F for the cooling season to calculate *ex post* savings. Cumulative changes resulted in an increase of reported kWh consumed—reduced kWh savings (86.4% realization) and decreased therms consumed, thus, increased therms savings (118% realization). Cumulatively, on a fuel-neutral basis, the project realized 117% of original savings estimate.
285	Ventilation Filtration vs. Make Up Air System	290,450	330,199	114%	8%	The team interviewed and requested data from the customer to confirm RTU efficiency and fan HP and found the RTU efficiency and fan HP was higher than used in *ex ante* calculations. The net effect of these modifications in *ex post* calculations was reduced kWh savings given an increase in performance case power consumption. The team revised the weather analysis to average winter temperatures, which slightly reduced the degree Fahrenheit value. This increased the total therms savings for the project.
2220	Boiler, Not Otherwise Specified	194,063	191,475	99%	6%	Application date of August 1, 2022. This project was implemented midyear, and while projected to be at a three shift operation from the start, was at a single shift ramp-up phase until February 1, 2023, at which point the customer added a second shift. The team interviewed and attained loading values from the customer prior to February 1, 2023. The team conducted a site visit in early February and observed loading values that confirmed higher loading than prior to February, but not at the level reported in *ex ante* calculations. The customer expects to bring on a third shift by end of March; by April 1, 2023, the boiler should be operating at loading used in *ex ante* calculations. The team discounted first-year savings to conservatively reflect the 50% loading pattern observed at the on-site visit in early February 2023. Given long EUL, this modification had minimal effect on the lifecycle therms savings.
285	Ventilation Filtration vs. Make Up Air System	18,354	17,542	96%	1%	The team interviewed the customer and confirmed the baseline fan specification and heating efficiencies matched the application data provided. The customer confirmed that while the intention was to install a 30 HP fan, they decided to upgrade to a 40 HP fan (at the same cost). *Ex post* electric calculations with a 40 HP fan resulted in different airflow and more negative electric savings (penalty) than outlined in *ex ante* calculations. The team reviewed *ex ante* heating savings calculations and found them accurate. Net effect is slight reduction in MMBtu lifecycle savings for the project, as therms savings outweigh electric penalties.
2643	VFD, HVAC Fan	137	247	180%	0%	*Ex ante* annual HOU were specified at 2,500. The team conducted a site visit and found store operating hours were closer to 5,100 annual HOU at minimum and programming of AHUs aligned with this longer run time. The team modified the HOU value in *ex post* calculation to reflect actual run hours for this store, which increased kWh savings realized.

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
4354	LED Fixture, Downlights, Interior	8	6	77%	0%	In *ex ante*, a PI review found differing likely baseline wattage than claimed on the application. The evaluation team agrees with the PI review and reduced the baseline wattage to the likely max wattage. The reduced wattage reduced savings.
3384	Retrocommissioning (RCx), Implementation, Part 2 Incentive	84,881	63,227	74%	11%	The team conducted an on-site visit and reviewed programming and trends with operators. As a result of COVID-19 and ever shifting hospital needs and pivots, the customer needed to modify the fan speed and schedules from original design parameters. The majority of fan-speed reduction modifications were still in place as of the site visit, with some exceptions. The customer made no modifications to the fan-speed measure given limited changes and provided no line by line calculations by AHU. The customer's primary change was to the AHU scheduling, scheduling most to turn off overnight. The evaluation team viewed trends on the fan speed for all 17 AHUs originally scheduled to turn off. Only two units turned off for any duration, albeit a shorter duration than originally designed. The remaining 15 units were operational throughout each night and had no schedule active to turn them off. Again, this is due to the need for conditioning in these spaces, not an oversight in the programming. The evaluation team has removed the savings for this single scheduling measure. Savings remain unchanged for the remaining four measures, although some modifications from the original design were noted for each. Recommend engaging in a larger discussion of how the RCx program is implemented; there were few standardized reports and calculations among the RCx projects sampled.

Agribusiness Offering (Business and Industry Solution)

The evaluation team found few discrepancies in realization rates for sampled projects in the CY 2022 Agribusiness Offering. In the impact sample, 29 of 32 projects achieved a 100% energy realization rate. Of those with discrepancies, one site had a realization rate below 80% (60%).

Table F-32 includes specific details about projects with discrepancies.

Table F-32. CY 2022 Agribusiness Offering Sample Detailed Projects

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
3989	Refrigeration Heat Recovery, NG WH, w/ a pre-cooler and VFD on milk pump, Ag	15	16	109%	0%	*Ex ante* and *ex post* calculations demonstrate actual therms savings of 10.88. *Ex ante* calculation rounded down this value to 10.0, and evaluated savings left the whole value of 10.88, which resulted in a slight discrepancy in final realized savings.
3987	VFD, Dairy Vacuum Pump, Agriculture	291	348	119%	0%	The project is for a small herd size of 80 cows (MMID 3987 is for more than 500 cows at the facility). *Ex post* calculation modified the MMID 5231 to match with this herd size. MMID 5231 does not have deemed kW savings associated with the measure. *Ex post* calculation used MMID 5231 deemed kWh savings per cow, which resulted in a higher realization rate for kWh.
3386	Grain Dryer, Energy Efficient, Hybrid	48,180	29,061	60%	2%	*Ex ante* values built on 2,000 growing acres claimed in the application. The participant reported via interview and collected data that 1,000 to 1,200 acres of land were used to grow corn. The remainder of the claimed land (800 to 1,000 acres) was used to grow other crops, such as beans, which did not require drying. Application indicates an average 200,000 bushels of corn processed that equates to roughly 1,200 acres. The grain dryer was only used to dry corn. The *ex post* calculation accounts for 1,200 acres of corn, which equals 200,000 bushels of corn processed through the dryer. The reduced acres attributed to corn and thus reduced drying resulted in a reduced therms realization rate.

Schools Offering (Schools and Government Solution)

The evaluation team found a few discrepancies in realization rates for sampled projects in the CY 2022 Schools Offering. In the impact sample, 22 of 25 projects achieved a 100% energy realization rate. Of those with discrepancies, two projects deviated significantly, defined as more than 20% above or below a 100% realization rate. Two projects had a realization rates of 50% and 65% (less than 80%). Table F-33 includes specific details about projects with discrepancies.

Table F-33. CY 2022 Schools Offering Sample Detailed Projects

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
2644	VFD, HVAC Heating Pump	229	115	50%	0%	*Ex ante* calculation considered two boiler VFD pumps for the savings calculations. Confirmed in customer interview and from BMS data analysis, only one boiler pump can run at a time as the facility has counter-flow issues. *Ex post* calculations accounted for a single-pump operation for the savings calculations, which resulted in a kWh realization rate of 50%. Original application assumed two pumps each ran for 3,000 hours, ramping up and down together. Trend data from January 2022 and customer interview indicated one boiler remained off the entire duration due to redundancy. The other mostly maintained minimum 30% speed, occasionally ramping to 54% speed. Total boiler operational period is 3,000, but only equivalent to one motor running (lead lag presumably, but not observed) for that duration.
2680	HVAC Controls, Not Otherwise Specified	158,885	138,139	87%	4%	To calculate the savings from the HVAC system and control upgrades, *ex ante* analysis used an energy modeling software approach. Both the existing and proposed case scenarios were modeled to determine energy savings. In this analysis, the *ex ante* pre-existing model was calibrated using 2019 kWh data for a portion of the chiller and building energy consumption. However, the evaluation team did not find calibration analysis for the proposed model. The team checked the fit of the proposed model using actual post-consumption data and found the CVRMSE to be 60% and the NMBE to be 64%. This is outside the ASHRAE calibration guidelines.
5081	Direct Fired Make-up Air Unit	341	221	65%	0%	During a phone interview, the customer reported reduced run hours from application data. The direct fired make-up air units (MAU) serves a new CNC plasma cutter that is placed in a metal shop and is controlled by a manual switch. Once pressed, the MAU stays on for 40 minutes, provides 100% outside air, and is equipped with heating coils. Cooling is provided by a dedicated RTU for this area. The MAU's function is to provide make-up air for the exhaust that turns on when the welding class is in effect. According to the participant, they have three 45-minute classes per day that use welding 50% of the time. The school operates for 38 weeks a year and is primarily off for the summer break from June to August. Three classes for 45 minutes per day equates to 2.25 hours per day. The annual operation for 38 weeks would be 427.5 hours per year, discounted by 50% equals 213.75 hours per year, as compared with 1,300 hours estimated by *ex ante* calculations. However, given manual operation, the team deems it reasonable to round up to a half school day to account for less than ideal operation of this unit and some overrun time. The participant confirmed that they planned for the setup and schedule as described above and do not expect any changes in the future. *Ex post* calculations use the same methodology as *ex ante* but update run time, which reduced therms savings.

Government Offering (Schools and Government Solution)

The evaluation team found a single discrepancy in realization rates for sampled projects in the CY 2022 Government Offering. In the impact sample, 14 of 17 projects achieved a 100% energy realization rate. One project deviated significantly achieving a 0% realization rate. Table F-34 includes specific details about projects with discrepancies.

Table F-34. CY 2022 Government Offering Sample Detailed Projects

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
2650	Wastewater Treatment, Not Otherwise Specified	177,412	0	0%	7%	From the project summary of this project, the energy efficiency opportunity is to retrofit its aeration tanks to flexible membrane diffusers. Off-gas testing has shown that this retrofit should improve oxygen transfer efficiency by 30% and reduce the airflow rate needed for treatment. The energy savings will be reduced in purchased natural gas therms for the aeration blowers. The process modification will allow the engine driven blowers to operate for the year on biogas and not require natural gas to be purchased to operate the blowers.
2455	LED, Not Otherwise Specified	87,705	84,067	96%	3%	The variation in the energy savings kWh is due to the reduced run hours for 112 fixtures (40 watts wall pack) on photocells from 8,760 hours to 4,296 hours for baseline and retrofit fixtures. These 112 fixtures account for a small portion of the total number of fixtures included in this sampled measure. During the on-site visit, the site engineer learned that both the baseline and retrofit outdoor wall packs have photocells and observed fixtures were off during the daytime site visit. Also, the peak coincident demand for the 112 fixtures on photocells would be zero as the outdoor lights stay off during the daytime hours.

Prescriptive Offering (New Construction Solution)

The evaluation team found no discrepancies in realization rates for all 21 sampled projects in the CY 2022 Prescriptive Offering in the Nonresidential New Construction Solution.

Design Assistance/Review Offering (New Construction Solution)

The evaluation team found a few discrepancies in realization rates for sampled projects in the CY 2022 Whole Building Design Assistance/Review Offering in the Nonresidential New Construction Solution. In the impact sample, 19 of 22 projects achieved a 100% energy realization rate. Of those with discrepancies, one project resulted in a significant deviation of 135%. Specific details related to projects with significant or impactful discrepancies are provided in Table F-35.

Table F-35. CY 2022 Design Assistance/Review Offering Sample Detailed Measures

MMID	Project Measure	Lifecycle Savings (MMBtu)		Real. Rate	Share of Offering	Notes
		Ex Ante	*Ex Post*			
2970	Project Savings Verification	282,750	380,323	135%	5%	The verified modelling report does not match the verified bundle results reported in the verification report. This project was modeled in File Builder, so the team did not have access to review or modify the model. The model output demonstrates 3,773,429 annual kWh savings and 61,412 annual therms savings. Those values remained unchanged in the *ex post* calculations. There appears to have been a data entry error, particularly for therms savings, which on a cumulative fuel neutral basis, resulted in a final realization rate of 135%.
5119	EDA - Project Savings and Verification	16,174	16,545	102%	0%	The *ex post* savings reflect the energy model SIM reports provided for this project, which did not match the verification report or the *ex ante* savings. The project was modeled using File Builder rather than NEO, so the team was not able to access the model for review or clarification. The SIM reports are identical to those included with the SPECTRUM documents for another customer facility location; however, they do not agree with the *ex ante* savings for that project either. The issue could be that the incorrect SIM reports were uploaded to SPECTRUM.
5119	EDA - Project Savings and Verification	16,987	16,545	97%	0%	The *ex post* savings reflect the energy model SIM reports provided for this project, which do not match the verification report or the *ex ante* savings. The project was modeled using File Builder rather than NEO, so the team was not able to access the model for review or clarification. The SIM reports are identical to those included with the SPECTRUM documents for another customer facility location; however, they do not agree with the *ex ante* savings for that project either. The issue could be that the incorrect SIM reports were uploaded to SPECTRUM.

Appendix G. Net Savings Analysis

For the CY 2022 evaluation of Focus on Energy's offerings, the evaluation team applied net-to-gross (NTG) adjustments drawn from historical primary research. This appendix describes which research findings the team applied to each offering.

Net Savings Overview

As described in Volume II, the evaluation of a solution and its offerings involves reviewing the reported gross savings to ensure that the measures installed have remained installed and are working as intended. The evaluation team then applies any adjustments found during that review to calculate verified gross savings.

Net savings are savings that would not have occurred in the absence of a given offering. These are the final savings attributed to an offering, as determined by an independent evaluator. To determine these savings, the evaluator deducts reported savings that are associated with freeriders (participants who would have undertaken the same action and achieved the same savings in the absence of an offering) and adds spillover savings (savings that are the result of an offering's influence, but for which no incentive was paid and for which no offering has recorded savings).

Net savings represent the total savings achieved through the investment of ratepayer dollars into the offering. These net savings are the primary benefits factored into the benefit/cost analysis used to help design offerings and ensure that they are operating in a manner that returns a net positive benefit to ratepayers. Focus on Energy also uses net savings to track progress toward the savings targets established for it by the Public Service Commission of Wisconsin (PSC).

For CY 2022, the evaluation team calculated net savings by applying historical NTG ratios or assuming an NTG of 1.0. In some cases, the team combined historical studies to determine the savings-weighted average NTG ratios for each offering. Table G-1 shows the evaluation methods used to determine net savings for each offering for the CY 2022 evaluation. The Midstream Offering was the only offering that had primary NTG research conducted in CY 2022.

Table G-1. CY 2022 Net Savings Methodology by Offering

CY 2022 Offerings	Net Savings Methodologies
Residential Offering	
Online Marketplace	CY 2021 Self-Report
Retail, Retail Lighting	CY 2021 National Lighting Sales Model
Retail, Income-Qualified	Assumed 100% NTG
Retail, Pop-Up Retail/Rural Retail Events	CY 2020 Self-Report
Retail, Retail Products	CY 2015 Self-Report
Heating and Cooling (Standard)	CY 2020 Standard Market Practice and CY 2020 Self-Report
Heating and Cooling (Income-Qualified)	Assumed 100% NTG
Insulation and Air Sealing	CY 2020 Billing Analysis
Renewable Energy	CY 2021 Self-Report
Residential New Construction	CY 2019 Billing Analysis

CY 2022 Offerings	Net Savings Methodologies
Nonresidential Offering	
Agriculture	CY 2020 Self-Report
Agriculture/Rural Farmhouse Kits	CY 2020 Self-Report from Packs Participant Surveys
Commercial and Industrial	CY 2020 Self-Report
Large Industrial	CY 2020 Self-Report
Government	CY 2020 Self-Report
Schools	CY 2020 Self-Report
New Construction Design Assistance/Review	CY 2020 Self-Report
New Construction Prescriptive	CY 2020 Self-Report
Renewable Energy	CY 2021 Self-Report
Midstream Offering	
Midstream	CY 2022 Self-Report from Participant Distributor, Contractor and End Users; CY 2022 Self-Report Delphi Panel

Midstream Offering Self-Report NTG Analysis Methodology

For each measure category offered through the Midstream Solution, the evaluation team used a distributor, contractor, and end-user causal pathway NTG methodology. This approach is based on methods used in California and other states for similar upstream/midstream offerings, most recently described in detail in the 2017 California Public Utilities Commission (CPUC) HVAC Impact Evaluation Report.[29]

The methodology establishes Midstream Offering attribution by considering the pathways distributors and contractors take when selling high-efficiency equipment and the related pathways end users take when purchasing equipment. The term "causal pathway" is used to represent how the offering is intended to influence the final purchase decisions of end users. This approach was used to integrate survey responses into freeridership and NTG values.

In this methodology, there are three main causal pathways of influence that can impact distributors and equipment end users, two of which also apply to contractors:

- The solution influences distributors to **stock** high-efficiency units, and what is in stock influences what end users purchase when their units fail. This causal pathway is driven by the assumption that when end users replace existing equipment in a pressing situation, the equipment kept in stock by distributors has a strong influence on their purchasing decisions.
- The solution encourages distributors and contractors to **upsell** high-efficiency units, and end users are influenced to purchase high-efficiency units rather than standard-efficiency units by promotional efforts.

29 DNV GL - Energy. April 1, 2019. 2017 *Impact Evaluation Report: HVAC (Appendix G. 6.12.1.1).* Prepared for California Public Utilities Commission. https://pda.energydataweb.com/api/view/2167/CPUC%20Group%20A%202017%20HVAC%20Impact%20Evaluation%20-%20Final%20Report.pdf

- The solution encourages distributors and contractors to reduce the **price** of high-efficiency units or pass along rebates to end users, and, in turn, end users are influenced by the lower prices to purchase high-efficiency units rather than standard-efficiency units.

Table G-2 lists the question themes associated with the three causal pathways for distributors, contractors, and end-use buyers.

Table G-2. Question Themes Associated with the Three Causal Pathways

Causal Pathways	Distributor Question Theme	End-User Question Theme
Stocking	1. What was the Midstream Solution influence on distributor stock?	1. How did the mix of equipment in stock influence the end user?
Upselling	2. What was the Midstream Solution influence on encouraging the distributor/contractor to promote or upsell the units?	2. What was the influence that distributor/contractor upselling had on the end user's decision?
Price	3. Did the distributor/contractor pass on some or all of the incentive to buyers?	3. What was the influence the price had on the end user's decision?

Each of the causal pathways is dependent on the distributor changing their behavior in response to the offering, and that change in behavior influencing the decision-making of their contractors and buyers. Each causal pathway is independently based on the assumption that if the solution failed to show attribution through the distributors, contractors, or buyers, then the solution did not affect the equipment sale on that particular causal path. This does not mean that the offering had no influence on the sale, only that any influence it had was not through this path. If another causal path did show offering influence, then the sale was at least partially attributable to the offering.

Table G-3 shows the distributor causal pathway attribution scoring approach for HVAC equipment incented through the Focus on Energy Midstream Solution.

Table G-3. Distributor Causal Pathway Attribution Scoring Approach

Distributor Causal Pathways	General Question Series Logic	Attribution Scoring
Stocking	**Has the solution influenced stocking patterns of high-efficiency units?** E5. For all [EQUIPMENT TYPE] approximately how many [EQUIPMENT TYPE] does your company normally keep available in stock? E6. Of those, how many are high efficiency? E7. If the solution weren't available, how many of these high-efficiency [EQUIPMENT TYPE] would you stock?	$\frac{(E6\ response - E7\ response)}{E6\ response}$ = Distributor $\text{Attribution}_{\text{Stock}}$
Upselling	**Has the solution influenced any upselling or promoting of high-efficiency units?** E14. In situations where you are selling [EQUIPMENT TYPE], about what percentage of the time are you currently recommending the high-efficiency equipment? E15. For [EQUIPMENT TYPE] equipment, what percent of the time would you have recommended the high-efficiency equipment had the solution not existed in 2020?	$\frac{(E14\ response - E15\ response)}{E14\ response}$ = Distributor $\text{Attribution}_{\text{Upsell}}$
Price	**Does any of the incentive get passed on to the buyer?** E19. By how much, percentage-wise, does the rebate impact the final price paid by the buyer?	$E19\ Response$ = Distributor $\text{Attribution}_{\text{Price}}$

Table G-4 shows the contractor causal pathway attribution scoring approach for HVAC equipment offered through the Focus on Energy Midstream Solution. This section is comparable to the same section for distributors.

Table G-4. Contractor Causal Pathway Attribution Scoring Approach

Contractor Causal Pathways	General Question Series Logic	Attribution Scoring
Upselling	**Has the solution influenced any upselling or promoting of high-efficiency units?** E7. In situations where you are selling [EQUIPMENT TYPE], about what percentage of the time are you currently recommending the high-efficiency equipment? E8. For [EQUIPMENT TYPE] equipment, what percentage of the time would you have recommended the high-efficiency equipment had the solution not existed in 2020?	$\frac{(E7\,response - E8\,response)}{E7\,response}$ = $\text{Contractor Attribution}_{\text{Upsell}}$
Price	**Does any of the incentive get passed on to the end-use buyer?** E13. On average, what percentage of the rebate is passed on to the buyer for the [EQUIPMENT TYPE], either directly or indirectly?	$E13\,Response$ = $\text{Contractor Attribution}_{\text{Price}}$

Note: While Cadmus is asking contractors general questions about whether they keep a supply of equipment in stock and if the Focus on Energy Midstream Equipment Solution influenced their stocking practices, HVAC contractors typically do not stock a significant amount of equipment. Therefore, a separate contractor stocking attribution score is not applicable.

Table G-5 shows the end-user causal pathway attribution scoring approach for HVAC equipment offered through the Focus on Energy Midstream Solution.

Table G-5. End-User Causal Pathway Attribution Scoring Approach

End-User Causal Pathways	General Question Series Logic	Attribution Scoring
Stocking	**How did the mix of equipment in stock influence the end user?** B6. Did any of this purchased equipment replace existing equipment? **No: 0 attribution** **Yes:** B7. Why did you have existing equipment replaced? **If existing equipment was functioning:** B8. How quickly did you need to replace your existing equipment? **If days > 5 then 0 attribution** **If days < 5 or exiting equipment was not functioning, then** B10. If the model and size of equipment you purchased was not available from your preferred vendor, which of the following would you have done? **Waited until the unit was in-stock = 0 attribution** **Contacted an alternate vendor to get the same equipment you wanted = 0 attribution** **Selected the next best available alternative:** B11. You indicated you would have selected the next best alternative that was available. Which of the following efficiency levels would that unit have been? **The same efficiency as what you purchased = 0 attribution** **Standard efficiency on the market at the time = 1 attribution** **Between standard efficiency and what you purchased = .5 attribution**	If **B6 = 'No'** then **End-User Attribution$_{Stock}$** = **0% attribution** If **B6 = 'Yes'** and **B8 = more than 5 days** then **End-User Attribution$_{Stock}$** = **0% attribution** If **B6 = 'Yes'** and **B8 = less than or equal to than 5 days** and **B10 = 'waited until the unit was in-stock'** or '**contacted an alternative vendor to get the same equipment you wanted'** then **End-User Attribution$_{Stock}$** = **0% attribution** If **B6 = 'Yes'** and **B8 = less than or equal to 5 days** and **B10 = 'selected the next best alternative'** and **B11 = 'the same efficiency as what your purchased'** then **End-User Attribution$_{Stock}$** = **0% attribution** If **B6 = 'Yes'** and **B8 = less than or equal to 5 days** and **B10 = 'selected the next best alternative'** and **B11 = 'Standard efficiency on the market at the time'** then **End-User Attribution$_{Stock}$** = **100% attribution** If **B6 = 'Yes'** and **B8 = less than or equal to 5 days** and **B10 = 'selected the next best** alternative' and **B11 = 'Standard efficiency on the market at the time'** then **End-User Attribution$_{Stock}$** = **50% attribution**
Upselling	**What was the influence that distributor/contractor upselling had on the end user's decision?** B14. Did the vendor recommend the equipment you eventually purchased? **No: 0 attribution** **Yes:** C10. For each of the factors listed, please rate how important it was in your decision. Use a scale from 1 to 5, with 1 meaning the factor was *not at all important* and 5 meaning the factor was *very important* in your decision to purchase the energy-efficient [MEASURE1][s]. **Recommendation from a contractor: Ctr rating** **Recommendation from a distributor: Dist rating** **If max rating of Ctr rating and Dist rating = '1' then attribution = 0, '2' attribution = .25, '3' attribution = .5, '4' attribution = .75, '5' attribution = 1.0** **Consistency check:** B15. How did the vendor influence your purchase decision?	If **B14 = 'No'** then **End-User Attribution$_{Upsell}$** = **0% attribution** If **B14 = 'Yes'** and **C10 max (Dist rating, Ctr rating) = '1'** then **End-User Attribution$_{Upsell}$** = **0% attribution** else if **'2'** then **End-User Attribution$_{Upsell}$** = **25% attribution** else if **'3'** then **End-User Attribution$_{Upsell}$** = **50% attribution** else if **'4'** then **End-User Attribution$_{Upsell}$** = **75% attribution** else if **'5'** then **End-User Attribution$_{Upsell}$** = **100% attribution**
Price	**What was the influence the price had on the end user's decision?** B17. Would you have been willing to spend more for the exact same equipment you purchased? **No: 1 attribution** B17a. In terms of dollars, how much more would you be willing to pay?	**% calculated to be less than incentive $** then **Distributor Attribution $_{Price}$** = **100% attribution** **% calculated to be more than incentive $** then **Distributor Attribution $_{Price}$** = **0% attribution**

The team calculated the overall participant survey-based attribution scores by averaging the survey attribution scores for end user, distributor, and, where applicable, contractor along each causal path. The team then subtracted the pathway scores from 1 to calculate a freeridership rate on each path. Next, the team averaged the three combined causal pathway freeridership scores together and subtracted the result from 1 to get the overall survey-based solution NTG value.[30]

The equations below show the flow of these calculations. The team calculated the end-user attribution scores from survey responses related to an individual purchase and the distributor and contractor attribution scores based on the equipment type the end user purchased, as demonstrated in the following algorithms:

$$\text{Combined Attribution}_{\text{Stock}} = \text{Average (Distributor Attribution}_{\text{Stock}}\text{, End-User Attribution}_{\text{Stock}}\text{)}$$

$$\text{Combined Attribution}_{\text{Upsell}} = \text{Average (Distributor Attribution}_{\text{Upsell}}\text{, Contractor Attribution}_{\text{Upsell}}\text{, End-User Attribution}_{\text{Upsell}}\text{)}$$

$$\text{Combined Attribution}_{\text{Price}} = \text{Average (Distributor Attribution}_{\text{Price}}\text{, Contractor Attribution}_{\text{Price}}\text{, End-User Attribution}_{\text{Price}}\text{)}$$

$$\text{Freeridership}_{\text{Stock}} = 1 - \text{Combined Attribution}_{\text{Stock}}$$

$$\text{Freeridership}_{\text{Upsell}} = 1 - \text{Combined Attribution}_{\text{Upsell}}$$

$$\text{Freeridership}_{\text{Price}} = 1 - \text{Combined Attribution}_{\text{Upsell}}$$

$$\text{Net to Gross} = 1 - \text{Average (Freeridership}_{\text{Stock}}\text{, Freeridership}_{\text{Upsell,}}\text{ Freeridership}_{\text{Price}}\text{)}$$

The evaluation team calculated the overall participant survey-based causal pathway attribution scores (NTG ratio) for measures in the Midstream Offering by averaging the lifecycle energy savings weighted survey attribution scores for the end user, distributor, and, where applicable, contractor along each causal path.

The overall participant survey-based attribution scores were then presented to Delphi Panel experts, who were given the opportunity to revise the aggregate estimate of net savings for the Commercial Kitchen Equipment and HVAC Equipment offerings.

The evaluation team recruited two sets of panels, each comprising experts in the field related to either commercial kitchen equipment or HVAC equipment. These experts included manufacturers, independent (non-program participating) distributors, contractors, and evaluators in other jurisdictions. Panelists were charged with determining an appropriate NTG, or attribution score, for each offering. In

30 The evaluation team recommended averaging causal pathway scores instead of using a multiplicative method. The use of a multiplicative method to combine probabilities should be avoided. See Keating, Ken. 2009. "Freeridership Borscht: Don't Salt the Soup." Presented at the 2009 International Energy Program Evaluation Conference. https://www.iepec.org/conf-docs/papers/2009PapersTOC/papers/012.pdf

addition, Delphi Panel experts were asked to revise their initial estimate to account for market effects stemming from the Midstream Solution. The Commercial Kitchen Equipment Offering panelists came to a consensus during round two of the Delphi Panel survey. The HVAC Offering panelists came to a consensus during round three of the Delphi Panel survey.

Nonparticipant Spillover

Effective program marketing and outreach generates program participation and increases general energy efficiency awareness among customers. The cumulative effect of sustained utility program marketing can affect customers' perceptions of their energy usage and, in some cases, motivate customers to take efficiency actions outside of Focus on Energy offerings. This is generally called nonparticipant spillover (NPSO)—that is, the energy savings caused by, but not rebated through, Focus on Energy's energy efficiency and renewable resource offerings.

To understand whether Focus on Energy's general and specific marketing efforts generated energy efficiency improvements outside of its incentives and offerings, the evaluation team collected spillover data through the CY 2021 evaluation year. These data were gathered via general population surveys conducted with randomly selected residential and nonresidential customers. The details of the spillover methodology and results are presented in the CY 2021 Evaluation Volume III report. A summary of the CY 2021 NPSO results are presented in Table G-6. The team applied the 2.8% NPSO estimate from CY 2021 in the total quadrennium residential portfolio net savings calculation. The CY 2021 NPSO for the nonresidential segment was 0.0%.

Table G-6. Quadrennial Nonresidential Nonparticipant Spillover Results

Portfolio Sector	Nonparticipant Spillover
Residential	2.8%
Nonresidential	0.0%

Appendix H. Summary of Confidence and Precision

Focus on Energy gives serious consideration to evaluation design to ensure that its offerings achieve the most accurate and reliable results possible under the available evaluation budget. The evaluation uses statistical confidence and precision standards as a key driver in determining the scale and scope of the evaluation design for each offering for which the net savings target is 90% confidence and 10% precision over the CY 2019-CY 2022 quadrennium. Across the whole of the Focus on Energy portfolio, the evaluation achieved 7% relative precision at 90% confidence for the quadrennium.

The evaluation team calculated the precision of final net first-year and lifetime energy savings estimates (MMBtu) at 90% confidence for each offering in the Focus on Energy portfolio. The precision reflects the uncertainty in the savings estimates due to measurement error, regression error, and sampling error. Measurement error refers to the uncertainty around engineering parameters derived from simulation or professional judgment, regression error refers to uncertainty around estimates derived from regression analysis, and sampling error refers to uncertainty introduced by estimating population parameters based on a sample.

After calculating standard errors, the evaluation team calculated the precision of the final estimates using the following formula:

$$relative\ precision = \frac{z\text{-}statistic * SE}{total\ net\ savings}$$

Where:

z-statistic	=	Critical value at a specific confidence level
SE	=	Standard error of the total net savings estimate
total net savings	=	Total net savings estimated based on the evaluation results

This appendix provides details on how the evaluation team calculated total net savings estimates and their standard errors.

Introduction to Statistical Uncertainty

The evaluation team collected data from surveys, billing histories, meters, and secondary sources including the technical reference manual (TRM) to estimate net savings for each offering and the portfolio. Statistical uncertainty is inherent in all activities for which samples or models are used to estimate a property of a population. Using sampled data is often preferred to save on the costs and time associated with studying an entire population and because random samples of the population provide sufficiently reliable results. The strength of an estimate is related to the amount of uncertainty or error around it, which is determined based on the statistical properties of sampled data and how they are used to make inferences about a population.

Statistical uncertainty comprises two parts: the confidence and the precision of the estimate. Confidence intervals show the range of values within which one expects the unknown population parameter to fall. Confidence refers to the probability that the true value of the metric of interest (such as kilowatt-hours saved) will fall within some level of precision.

A statement of precision without a statement of confidence is misleading. For example, if energy savings is estimated as 24 kWh with precision of ±5 kWh at 90% confidence, the interpretation is that one is 90% confident that the true energy savings is between 19 kWh and 29 kWh. Narrower confidence intervals indicate that the savings estimate is very precise, and wider confidence intervals indicate that the variability in the data is large and that more information would be required to produce a more precise estimate.

For the Focus on Energy evaluation, the general standard for uncertainty is to achieve evaluation results with 90% confidence and 10% precision over the CY 2019-CY 2022 quadrennium. Evaluation activities are defined and prioritized to align with this standard. This standard is in line with nationwide best practices for the evaluation of energy efficiency programs, as documented in the U.S. Environmental Protection Agency's National Action Plan for Energy Efficiency and elsewhere.[31]

Combining Net Uncertainty with Gross Uncertainty

When two estimates are based on different evaluation activities and combined to produce a final estimate, the uncertainty from each estimate must be considered in calculating the uncertainty of the final estimate. For example, if one set of data collected from surveys, billing analyses, metering, and/or TRM review is used to estimate gross savings and another set of data collected from a separate survey is used to estimate spillover, freeridership, and net-to-gross (NTG) ratios and then that NTG ratio is applied to the gross savings to estimate net savings, the standard error of total net savings should be based on the standard error of gross savings and the NTG ratio. Details are provided below, specific to each set of offerings.

When the evaluation team estimates NTG ratios using survey data collected from an independent simple random sample of participants, it uses a ratio estimator and its standard error formula to quantify the uncertainty in the NTG ratios where net savings are represented by y_i, *ex post* savings are represented by x_i, and the standard error of the NTG ratio estimate is represented by SE_{NTG}, in the following formulas:

$$NTG\ Ratio = \frac{\sum_{sample} y_i}{\sum_{sample} x_i}$$

$$SE_{NTG} = \sqrt{\sum_{i=1}^{n} \frac{(y_i - NTG\ Ratio * x_i)^2}{\bar{x}^2 * n(n-1)}}$$

[31] U.S. Environmental Protection Agency. Accessed April 2021. "Energy and the Environment. National Action Plan for Energy Efficiency." https://www.epa.gov/energy/national-action-plan-energy-efficiency

The evaluation team then multiplies the NTG ratio to the total *ex post* gross savings to estimate total net savings and uses the formula for the standard error of the product of two independent random variables to calculate precision, as shown in this formula:

$$SE_{total\ net\ savings} = \sqrt{\begin{array}{c} NTG^2 * SE^2_{total\ ex\ post\ gross\ savings} + \ total\ ex\ post\ gross\ savings^2 * \\ SE^2_{NTG} + SE^2_{NTG} * SE^2_{total\ ex\ post\ gross\ savings} \end{array}}$$

The evaluation team used this method for all offerings unless otherwise noted.

Nonresidential Offerings

The evaluation team selected a sample of projects in each nonresidential offering to estimate *ex post* verified gross savings. It used a stratified sample design with a random stratum and a census stratum in most offerings. Sampling took place throughout the evaluation year in three waves. The evaluation team placed projects whose savings were above a percentage threshold of total offering savings in the census stratum. The sample design was successful in achieving low precision values for all offerings, as seen in the 2022 precision results.

The evaluation team applied the realization rates to the population total *ex ante* savings in each offering by wave to estimate that wave's population total *ex post* gross savings. It calculated realization rates and standard errors in the random stratum in each wave using the formulas presented in the Uniform Methods Project sampling chapter.[32]

In the following formulas, y_i represents *ex post* savings for each evaluated measure, x_i represents *ex ante* savings for each measure, and n represents each wave's sample size.

$$RR_{random\ stratum} = \frac{\sum_{sample} y_i}{\sum_{sample} x_i}$$

$$random\ stratum\ ex\ post\ gross\ savings = RR_{random\ stratum} * \sum_{random\ stratum\ population} x_i$$

$$SE_{random\ stratum\ total\ ex\ post\ gross\ savings} = \frac{\sum_{random\ stratum\ population} x_i}{\sqrt{n} * \bar{x_i}} * \sqrt{\sum_{i=1}^{n} \frac{(y_i - RR * x_i)^2}{n-1}}$$

The team also calculated realization rates for the census stratum in each offering. In the census stratum, all projects are evaluated in order to directly verify the largest saving projects. The census stratum has no sampling error. To estimate a single standard for each wave's combined census and random strata, the evaluation team used the following formula.

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32 National Renewable Energy Laboratory. April 2013. *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* "Chapter 11: Sample Design Cross-Cutting Protocols." Prepared by Cadmus. http://energy.gov/sites/prod/files/2013/11/f5/53827-11.pdf

$$SE_{wave\ total\ ex\ post\ gross\ savings} = \sqrt{(SE_{random\ stratum\ total\ ex\ post\ gross\ savings})^2 + (SE_{census\ stratum\ total\ ex\ post\ gross\ savings})^2}$$

As the standard error of the census stratum is zero, the standard error for the wave simplifies to the following:

$$SE_{wave\ total\ ex\ post\ gross\ savings} = SE_{random\ stratum\ total\ ex\ post\ gross\ savings}$$

The following formulas show the realization rate calculations for the census stratum and the method for calculating a single realization rate for the wave. The team used similar methods to combine census and random stratum standard errors and realization rate within waves and across waves.

$$RR_{census\ stratum} = \frac{\sum_{census} y_i}{\sum_{census} x_i}$$

$$census\ stratum\ ex\ post\ gross\ savings = RR_{census\ stratum} * \sum\nolimits_{census\ stratum\ population} x_i$$

$$RR_{wave} = \frac{random\ stratum\ ex\ post\ gross\ savings + census\ stratum\ ex\ post\ gross\ savings}{\sum_{wave} x_i}$$

The team estimated nonresidential NTG ratios using survey data collected from an independent simple random sample of participants then multiplied these ratios with the total *ex post* gross savings to estimate total net savings for each offering. The team used a ratio estimator and standard error formula described above to quantify the uncertainty in the NTG ratios.

Table H-1 presents the precision of total net first and cumulative year MMBtu savings estimates at 90% confidence for each nonresidential offering by program year. The sources of uncertainty in all nonresidential savings estimates were due to estimating the realization rate and NTG values based on samples.

Table H-1. Nonresidential Net First-Year MMBtu Energy Savings Precision

Nonresidential Offerings	Precision at 90% Confidence			
	CY 2020	CY 2021	CY 2022	Cumulative [a]
Agribusiness	13%	9%	9%	7%
Commercial and Industrial	17%	17%	17%	9%
Schools	12%	12%	12%	7%
Large Industrial	12%	12%	13%	7%
Government	12%	12%	12%	7%
New Construction: Design	25%	25%	25%	15%
New Construction: Prescriptive	19%	19%	19%	11%
Renewable Energy Competitive Incentive	9%	9%	N/A	8%
Renewable Rewards	13%	22%	N/A	9%
Total				**8%**

[a] Between CY 2019 and CY 2020, the nonresidential programs were reorganized. CY 2019 precision was calculated at the program level, which does not align with the offerings in CY 2020 to 2022; therefore, cumulative precision does not include CY 2019.

Residential Offerings

The evaluation team used various methods to evaluate the residential offerings. Table H-2 presents the precision of total net savings estimates and the sources of uncertainty for each residential offering, by program year as well as cumulative.

Table H-2. Residential Net First-Year MMBtu Energy Savings Precision (90% Confidence)

Residential Offerings	Precision at 90% Confidence					Sources of Uncertainty
	CY 2019	CY 2020	CY 2021	CY 2022	Cumulative	
Appliance Recycling [a]	38%	32%	N/A	N/A	19%	UEC model, part use, and NTG ratio
Trade Ally Solutions [b]	2%	3%	3%	4%	2%	PRISM model, NTG ratio
New Construction	122%[c]	8%	8%	8%	30%	PRISM model
Retail	53%	13%	15%	7%	14%	ISR and NTG ratio
Packs	2%	3%	3%	2%	1%	Survey estimated ISRs and NTG ratios
Online Marketplace	10%	3%	3%	6%	3%	ISR and NTG ratio
Total					**9%**	

[a] The Appliance Recycling offering was discontinued after CY 2020.
[b] Whole-home and HVAC measures did not map to current offerings in Trade Ally Solutions. To calculate cumulative precision across years, precision was rolled up across offerings.
[c] High relative precision around first-year MMBtu savings in the New Construction offering resulted from a small savings estimate (0.004 therms/sq ft).
ISR = in-service rate
PRISM = PRInceton Scorekeeping Method
UEC = unit energy consumption

Appendix I. Cost-Effectiveness and Emissions Methodology and Analysis

When developing potential offerings, APTIM, the Focus on Energy administrator, assesses the cost-effectiveness of offering designs prior to their implementation. The administrator, in collaboration with the Public Service Commission of Wisconsin (PSC) and the evaluation team, developed a cost-effectiveness calculator tool. Because maintaining consistency between planning and evaluation approaches is critical to understanding offering performance compared with expectations, the evaluation team used the same calculator to evaluate cost-effectiveness in CY 2022. Its findings are presented in this appendix.

The PSC considers the modified total resource cost (TRC) test to be the primary test in assessing the cost-effectiveness of both individual offerings and the entire Focus on Energy portfolio.[33] The PSC also directs that four additional tests be conducted for advisory purposes. These are an expanded TRC test that includes net economic benefits, the utility administrator cost test (UAT), the ratepayer impact measure (RIM) test, and the societal test. Beginning with the CY 2020 evaluation, the PSC has approved the inclusion of the avoided costs associated with reduced needs for transmission and distribution (T&D) infrastructure.[34]

Net-to-gross (NTG) ratios can have a significant effect on the results of the tests. NTG ratios are applied to adjust the energy savings impacts of the offerings so they reflect only the net gains that result. Therefore, NTG ratios account for energy savings that would have been achieved without the efficiency offerings as well as participant spillover (when NTG is less than 1, savings are removed; when NTG is greater than 1, savings are added). In all cases, the savings are multiplied by NTG.

On the cost side, expenditures that would have occurred without the efficiency effort are also removed. Costs that would not have occurred in the absence of the offerings—such as delivery and administrative costs—are not impacted by NTG.

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33 The use of the modified TRC test as the primary cost-effectiveness test is directed by the PSC. Public Service Commission of Wisconsin. September 3, 2014. Quadrennial Planning Process II – Scope. Order PSC Docket 5-FE-100, REF#: 215245. Order was updated on June 6, 2018. Quadrennial Planning Process III. Order PSC Docket 5-FE-101, REF#: 343509. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909.

34 The calculation method and inclusion of avoided transmission and distribution costs are directed by the PSC. Public Service Commission of Wisconsin. March 10, 2021. Quadrennial Planning Process III . Order PSC Docket 5-FE-101, REF#: 406591. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=406591.

Test Descriptions

The evaluation team—as well as the administrator in developing its cost-effectiveness calculator—uses methods adapted from the California Standard Practice Manual, the conventional standard of cost-effectiveness analysis for energy efficiency programs in the United States.[35] The five tests—the modified TRC test, the expanded TRC test, the UAT, the RIM test, and the societal test—are described in this section.

Modified Total Resource Cost Test

The TRC test is the most commonly applied test for evaluating the cost-effectiveness of energy efficiency and renewable resource programs around the country. Applications range across states and utility jurisdictions, from the standard TRC test to the societal test, which expands the test inputs to provide a more holistic societal perspective. The test includes total participant and administrator costs and benefits and also some non-energy benefits (such as emission reduction benefits). Modifications to the standard TRC test often involve reducing the discount rate or including various environmental and other non-energy benefits.

The modified TRC test used for the CY 2022 evaluation determines if the offerings are cost-effective from a regulatory perspective (as directed by the PSC) and is intended to measure the overall impacts of the benefits and costs of these offerings on the state of Wisconsin. The test compares all benefits and costs that can be measured with a high degree of confidence, including any net avoided emissions that have commission-established values. The test's purpose here is to determine if the total costs residents, businesses, and Focus on Energy incur for operating the offerings are outweighed by the total benefits they receive.

In simple terms, the benefit/cost value of the modified TRC test is the ratio of avoided utility and environmental costs from avoided energy consumption to the combination of administrative costs, delivery costs, and net participant incremental measure costs.

The benefit/cost equation used for the modified TRC test is:

$$TRC\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions] * NTG}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

Where:

$$Value\ of\ Gross\ Saved\ Energy = Net\ Gross\ Savings\ x\ Utility\ Avoided\ Costs$$

Expanded Total Resource Cost Test with Net Economic Benefits

The evaluation team investigated the impact of expanding the TRC to include net economic benefits for the CY 2022 offerings. The evaluation team conducts analysis of economic benefits every two years and issues the results separately from the evaluation reports.

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35 California Public Utilities Commission. July 2002. California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. http://www.calmac.org/events/SPM_9_20_02.pdf

This is the benefit/cost equation used for the expanded TRC test with net economic benefits:

$$TRC\,\frac{B}{C} = \frac{[(Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions) * NTG + Net\ Economic\ Benefits]}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

Utility Administrator/Offering Administrator Cost Test

The evaluation team also assessed the portfolio's cost-effectiveness using the UAT, which measures the net benefits and costs of the offerings as a resource option from the perspective of the Focus on Energy administrator. In Wisconsin, the UAT represents the collective perspectives of the participating utilities that hire and fund the administrator.

The UAT, previously called the revenue requirements test, effectively estimates the impacts on utility revenue requirements (the costs of providing service) by comparing the benefits of avoided utility costs from avoided energy consumption with the combined costs of operating the offering, such as incentive payments, administrative costs, and delivery costs. A positive benefit/cost ratio indicates that the offering improves an energy system's operational cost-effectiveness.

For this evaluation, the UAT's benefit/cost value indicates whether the combined revenue requirements from all participating utilities increase or decrease as a result of the Focus on Energy offerings. The net benefits determined with the UAT indicate the estimated dollar value of the change in the combined revenue requirements from all participating utilities. The NTG ratio impacts only the benefit side of the UAT because none of the costs would have occurred absent the effort and, therefore, all are kept in the test (not subtracted from the denominator).

The benefit/cost equation used for the UAT is:

$$UAT\,\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy * NTG]}{[Participant\ Incentives +\ Adminstrative\ Costs\ +\ Delivery\ Costs]}$$

Ratepayer Impact Measure Test

Generally, the RIM test indicates the isolated and marginal effect on utility energy rates from changes in revenues and operating costs caused by energy efficiency and renewable resource programs, all else being equal. It does not, however, provide a comprehensive picture of ratepayer impacts. The RIM test's estimated effects are theoretical and assume annual rate cases that may, in fact, not take place. Furthermore, the RIM test does not account for non-energy benefits enjoyed by ratepayers, nor does it clearly distinguish between rate and total bill impacts.

From the RIM test perspective, the relatively expansive view of program costs, particularly the inclusion of lost revenues—which are foregone revenues as opposed to new costs—from avoided energy consumption, leads most energy efficiency and renewable energy programs to be considered not cost-effective. Exceptions include demand response programs or programs targeted to the highest marginal cost hours (when marginal costs are greater than rates). In simple terms, the RIM test benefit/cost value is the ratio of avoided utility costs and the combination of participant incentives, administrative costs, and lost utility revenue.

The benefit/cost equation used for the RIM test is:

$$RIM\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy * NTG]}{[Participant\ Incentives + Adminstrative\ Costs\ +\ Lost\ Revenue * NTG]}$$

For this evaluation, a RIM test benefit/cost value less than 1 indicates that Focus on Energy will induce theoretical upward pressure on rates because the decrease in utility revenues caused by its offerings is greater than the avoided utility costs (net benefits are negative) and vice versa. Conversely, a value greater than 1 indicates that Focus on Energy will induce theoretical downward pressure on rates because the decrease in revenues is less than the avoided utility costs.

Results from the RIM test are better understood within the context of UAT results. The most common combination of results involves a UAT benefit/cost value greater than 1 and a RIM test benefit/cost value less than 1. Passing the UAT means that revenue requirements (revenue needed to operate the utility business and deliver energy services) will decrease as a result of the programs; in other words, the utilities are running more efficiently because of their programs.

However, if the programs do not pass the RIM test, it means the improvement in efficiency and the associated decrease in revenue requirements were not sufficient to offset the lost revenues. As a result, the programs will put upward pressure on rates. Rates are roughly estimated as in this formula:

$$\frac{revenue\ requirement}{sales\ (kWh\ or\ therms)}$$

The numerator (revenue requirement) decreases, but so does the denominator (sales). If the denominator decreases more than the numerator, the ratio of the two will increase. In this scenario, although all rates may theoretically increase, the energy bills for participants will decrease and the energy bills for nonparticipants will increase. The decrease in revenue requirement means that the decrease in participant bills will exceed the increase in nonparticipant bills such that the average bills across the two customer groups will decrease.

In essence, the RIM test is not a cost-effectiveness (efficiency) test in an economic sense but, rather, an analysis of the distributional (equity) impacts on energy bills.[36] Because Focus on Energy offerings are designed to meet a statutory requirement to make offering benefits available to all ratepayers, the RIM test results for Focus on Energy are influenced by the success of its offerings in meeting that requirement, its ability to meet that requirement within existing resources, and its customers' individual willingness to participate.

The RIM test assumes that a true-up will occur every year through rate cases. The test as applied could be considered the worst-case scenario. The RIM test also does not consider any societal or system benefits that accrue to all customers.

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36 The RIM test assumes annual rate cases that may not take place. If there is not an annual rate adjustment, there is a transfer payment to participants from utility shareholders rather than from nonparticipants.

Societal Test

In addition to the expanded TRC, the evaluation team investigated the impact of several non-energy benefits such as health, water, purchase deferral, property value, and arrearage benefits that are included in the CY 2022 offerings.

The benefit/cost equation used for the societal test is the following:

$$SOC\frac{B}{C} = \frac{[(Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions) * NTG + Net\ Economic\ Benefits + NEBs]}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

A more detailed discussion of the various non-energy benefits in the societal test are presented below.

Non-Energy Benefits

Table I-1 summarizes the non-energy benefits from the five metrics that have been quantified in this analysis. The five metrics are health benefits, water benefits, purchase deferral benefits, property value benefits, and income-qualified arrearage benefits. Each benefit is further described in the following sections.

Table I-1. Non-Energy Benefits Results Summary

Benefit	Value	Unit
Health Benefit	$0.0311	per kWh
Water Benefits - Residential	$0.0086	per gallon
Water Benefits - Commercial	$0.0085	per gallon
Purchase Deferral	Measure specific	Measure specific
Property Values	$8,923	per home
Arrearages	$24.65	per participant

Health Benefits

The evaluation team estimated the value of health benefits accumulated by reduced emissions attributable to offering activity. The team followed the method recommended by the U.S. Environmental Protection Agency (EPA) using the benefits per kilowatt-hour (BPK) tool. The BPK tool was introduced by the EPA in late fall 2019, using data from 2017, to help interested parties estimate health benefits from reduced emissions. It was updated in spring 2021, using data from 2019. In 2023, a literature scan confirmed that the 2021 update remained the most up to date.

The BPK tool relies on the AVoided Emissions and geneRation Tool (AVERT) regional inputs, which specify the blend of electric generation sources (coal, natural gas, hydroelectric, other renewables, etc.) and the downstream effects of particulate generation from those sources as determined in the Co-Benefits Risk Assessment (COBRA) health impacts screening and mapping tool.

BPK values are determined using the following equation:

$$BPK_{t,r} = \frac{HealthBenefits_{t,US}}{GenerationChange_{t,r}}$$

Where:

$BPK_{t,r}$	=	Annual monetized public health benefits per kilowatt-hour (c/kWh) for each energy efficiency/renewable energy technology type (t) and AVERT region (r)
Health $Benefits_{t,US}$	=	Aggregated monetized public health benefits from emissions reductions for each type of energy efficiency/renewable energy technology (t) for the contiguous United States (US) in 2019 dollars
Generation $Change_{t,r}$	=	Change in electricity generation for each energy efficiency/renewable energy technology type (t) and AVERT region (r)

The effects of these emissions are then tied to the negative health outcomes associated with inhalation of those particulates. Table I-2 lists these included health inputs, along with the savings associated with each input. The in-depth methodology for the calculation of these benefits is available in a 2021 report on public health and energy from the EPA.[37]

[37] U.S. Environmental Protection Agency. May 2021. *Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report.* https://www.epa.gov/sites/default/files/2021-05/documents/bpk_report_second_edition.pdf

Table I-2. Included Health Inputs

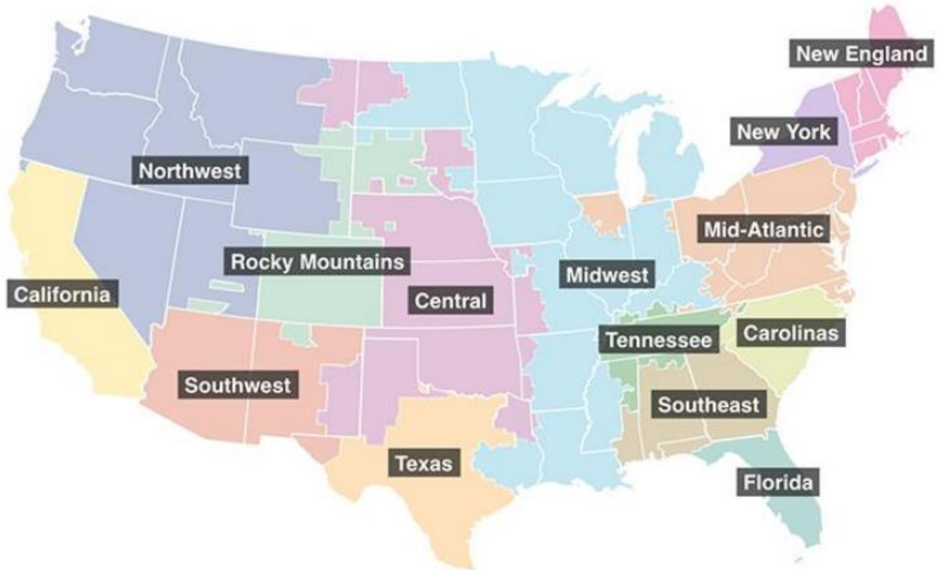
Health Endpoint	Age Range
Mortality[a]	25–99
Infant Mortality[b]	0–0
Acute Myocardial Infarction, Nonfatal[c]	0–24
Acute Myocardial Infarction, Nonfatal[c]	25–44
Acute Myocardial Infarction, Nonfatal[c]	45–54
Acute Myocardial Infarction, Nonfatal[c]	55–64
Acute Myocardial Infarction, Nonfatal[c]	65–99
Acute Myocardial Infarction, Nonfatal[d]	0–24
Acute Myocardial Infarction, Nonfatal[d]	25–44
Acute Myocardial Infarction, Nonfatal[d]	45–54
Acute Myocardial Infarction, Nonfatal[d]	55–64
Acute Myocardial Infarction, Nonfatal[d]	65–99
Hospital Admissions, All Cardiovascular (less-acute myocardinal infraction)	18–64
Hospital Admissions, All Cardiovascular (less-acute myocardinal infraction)	65–99
Hospital Admissions, All Respiratory	65–99
Hospital Admissions, Asthma	0–17
Hospital Admissions, Chronic Lung Disease	18–64
Asthma Emergency Room Visits (Smith et al. 1997)	0–99
Asthma Emergency Room Visits (Stanford et al. 1999)	0–99
Acute Bronchitis	8–12
Lower Respiratory Symptoms	7–14
Upper Respiratory Symptoms	9–11
Minor Restricted Activity Days	18–64
Work Loss Days	18–64
Asthma Exacerbation (cough, shortness of breath, or wheeze)	6–18

[a] Mortality value after adjustment for 20-year lag.
[b] Infant mortality value is not adjusted for 20-year lag.
[c] Based on Russell (1998).
[d] Based on Wittels (1990).

Source: U.S. Environmental Protection Agency

To determine Wisconsin-specific values, the evaluation team used the cost of emissions generated across the AVERT region that covers the state (Midwest, as shown in Figure I-1). The team assumed a 2% discount rate to comply with decisions by the PSC for Quadrennial Planning Process III, the current Focus on Energy period.

Figure I-1. U.S. EPA AVERT Regions



Source: U.S. Environmental Protection Agency.

The two inputs specific to Wisconsin health benefits are a low estimate value of 3.11 cents/kWh and a high estimate value of 7.01 cents/kWh, as presented in Table I-3. The evaluation team determined that the lower of the two value ranges was the most appropriate to use because it provides the most conservative estimate of offering-induced health benefits.

Table I-3. Wisconsin Specific Health Benefits

Region	Technology	Cents/kWh (Low Estimate)	Cents/kWh (High Estimate)
Upper Midwest	Uniform energy efficiency	3.11	7.01

Aggregated health benefits are subsequently generated by applying the 3.11 cents/kWh to the first five years of lifecycle program savings, a shorter period than is claimed for lifetime emissions benefits. This is in line with EPA recommendations not to extend savings beyond the five-year threshold because of the uncertainty in the share of generation each region is expected to draw from various fuel sources during that period and for the likelihood of revisions to health savings assumptions as the tool is regularly updated.

For example, coal generation is expected to start being supplanted by natural gas and renewable sources, which are less polluting than coal and which may substantially reduce the risk of certain specific negative healthcare outcomes while leaving others unaffected.

Water Benefits

The evaluation team estimated participant water delivery and wastewater bill savings attributed to reductions in volumetric water consumption accrued over the lifetime of efficient measures installed. These benefits are estimated for each offering by the following equation:

$$\sum_{Measure=1}^{n} Units_{Measure} \times PV(Water\ Savings\ Per\ Unit_{Measure} \times Marginal\ Cost\ of\ Water, EUL_{Measure})$$

Where PV indicates a present value function that takes annual bill savings and number of periods as inputs and n indicates the count of unique measures installed within a particular offering.

The marginal cost of water is then shown in this equation:

$$Marginal\ Cost\ of\ Water = (Marginal\ Cost\ of\ Water\ Delivery\ + Marginal\ Cost\ of\ Wastewater\ Service)$$

The evaluation team acquired input data from various sources:

- Measure quantity ($Units_{Measure}$) data were provided directly by Focus on Energy on an offering-by-offering basis.
- Volumetric water savings attributed to the efficient measure relative to some baseline measure ($Water\ Savings\ Per\ Unit_{Measure}$) was acquired from the Wisconsin Technical Reference Manual (TRM). The evaluation team scaled the savings data by the NTG ratio for each offering.
- The water delivery rate ($Marginal\ Cost\ of\ Water\ Delivery$) was estimated using a weighted averaging algorithm from a sample of 25 water utilities in Wisconsin. This sample includes the 10 largest water utilities in Wisconsin, a random sample of 10 utilities from the smallest 50% of utilities in Wisconsin, and a random sample of five additional utilities in Wisconsin, where size is measured by average number of customers served.[38]

  From these 25 utilities, the evaluation team calculated average marginal (volumetric) delivery rates for each utility for both residential and commercial sectors by taking the arithmetic mean of the highest and lowest rate tiers charged by each utility.[39] The team then calculated overall rate estimates by taking weighted averages of these utility-specific averages for both residential and commercial sectors, where each utility's weight is proportional to the utility's average number of customers relative to the sum of each utility's average number of customers for all utilities included in the sample. The final water delivery rate estimates for Wisconsin are $3.31 and $3.23 per 100 cubic feet for residential and commercial sectors, respectively.

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38 Utility sales data was acquired from the PSC's E-Services Portal. The evaluation team used 2021 and 2020 water sales data. Public Service Commission of Wisconsin. February 2022. E-Services Portal: Municipal Annual Report Data. https://apps.psc.wi.gov/ARS/WEGSqueries/default.aspx

39 Utility tariff data were acquired from the Public Service Commission of Wisconsin's E-Services Portal. Public Service Commission of Wisconsin. February 2022. E-Services Portal: Utility Tariffs. https://apps.psc.wi.gov/RATES/tariffs/default.aspx?tab=4

Table I-4 summarizes the weighted averaging algorithm applied to residential rates in Wisconsin by showing intermediate calculation outputs.[40]

Table I-4. Residential Water Rate Algorithm Example

Utility Size Bracket	Rank by Gallons Sold	Utility Name	Average Number of Customers	Weight (Utility Customers/ Customers in Sample)	Highest/Lowest Tier Rates	Rate Average
Top 10	1	Milwaukee Water Works	161,425	35.1%	$2.14	$2.14
	2	Madison Water Utility	70,053	15.2%	Low: $3.44; High: $9.54	$6.49
	3	Racine Water Works Commission	34,644	7.5%	Low: $2.41; High: $3.11	$2.76
	4	Green Bay Water Utility	36,028	7.8%	Low: $1.89; High: $2.66	$2.28
	5	City of Oshkosh Water Utility	24,106	5.2%	Low: $4.26; High: $5.12	$4.69
	6	Janesville Water Utility	24,495	5.3%	Low: $2.19; High: $3.70	$2.95
	7	Appleton Water Department	28,086	6.1%	Low: $3.50; High: $4.55	$4.02
	8	Fond Du Lac Water Utility	16,190	3.5%	Low: $4.31; High: $4.74	$4.53
	9	City of Waukesha Water Utility	20,662	4.5%	Low: $2.94; High: $4.88	$3.91
	10	Kenosha Water Utility	31,258	6.8%	Low: $1.76; High: $2.26	$2.01
Random Sample of 10 from Smallest 50%	338	Crandon Water And Sewer Utility	730	0.2%	Low: $1.50; High: $2.13	$1.81
	365	Arlington Water Utility	375	0.1%	$8.54	$8.54
	392	Hixton Municipal Water Utility	229	0.0%	Low: $4.58; High: $5.20	$4.89
	402	Town of Farmington Sanitary District	142	0.0%	Low: $4.00; High: $6.73	$5.37
	404	Lannon Municipal Water Utility	381	0.1%	$4.47	$4.47
	426	Clyman Utility Commission	175	0.04%	Low: $0.91; High: $1.18	$1.05
	507	Loganville Municipal Water and Sewer Utility	144	0.03%	$3.83	$3.83
	508	Lowell Municipal Water And Sewer Utility	117	0.03%	$5.16	$5.16
	515	Stone Lake Sanitary District	138	0.03%	$3.44	$3.44
	535	Town of Knight Municipal Water Utility	113	0.02%	Low: $4.25; High: $4.52	$4.38
Random Sample of Five from Through out	97	River Falls Municipal Utility	5935	1.3%	Low: $1.04; High: $1.92	$1.48
	157	Algoma Sanitary District No 1	1314	0.3%	$3.85	$3.85
	175	Village of Lake Hallie Public Works	2019	0.4%	Low: $0.00; High: $2.43	$1.22
	253	Thorp Municipal Water And Sewer Utility	808	0.2%	Low: $3.61; High: $5.40	$4.50
	451	Granton Municipal Water Utility	188	0.04%	Low: $6.66; High: $7.03	$6.84
Final Rate Estimate						**$3.32**

[40] Some participants obtain water from sources outside of conventional water delivery from a water utility, such as from natural bodies of water. These participants are not subject to the same marginal cost of delivery charged by water utilities. Because of an inability to reliably identify the source of water saved by program participants, the evaluation team conservatively assumes a water bill savings of $0 for those larger customers.

- The wastewater service rate ($Marginal\ Cost\ of\ Wastewater\ Service$) estimate was constructed from a population-weighted average of marginal (volumetric) wastewater charges for 326 (41%) Wisconsin wastewater service territories. The evaluation team acquired population and volumetric charge data from the Wisconsin Sewer User Charge Survey Report.[41] The final water wastewater estimate is $3.11 per 100 cubic feet for both residential and commercial. This estimate accounts for the prevalence of utilities with no volumetric wastewater charge. The team used the same values and method as in 2019 due to a lack of updated data on wastewater service rates for 2022.
- The evaluation team conducted a well water pump analysis to estimate the water delivery rate for the population that uses privately owned wells and pump systems rather than being connected to the municipal system. According to the research, 31% of the Wisconsin population uses privately owned wells.[42] By applying a weighted average to the water delivery rates to reflect both water delivery types, the water delivery rate for residential was calculated as $0.0044 per gallon.
- The commercial sector costs of $3.24 for delivery and $3.11 for wastewater per 100 cubic feet of water equates to $0.0086 per gallon. This figure does not assume any well water for commercial use.
- The expected useful life of an efficient measure ($EUL_{Measure}$) was provided by the TRM.
- The evaluation team assumed a real annual interest rate of 2%.

Purchase Deferral

Purchase deferral benefits account for the avoided costs of future baseline measure replacement in cases where the useful life of an efficient measure exceeds the useful life of the baseline measure it replaces. The evaluation team estimated purchase deferral benefits for lighting and non-lighting measures.

Lighting

Purchase deferral benefits for lighting measures were estimated on an expected useful life (EUL) basis, where the lifetime of efficient measures (fixtures and lamps) tends to exceed those of their corresponding baseline measures.

The evaluation team assumes that participants of Focus on Energy offerings would have replaced each baseline measure with an identical baseline or equivalent at regular intervals equal to the baseline measure's useful life. Purchase deferral benefits are estimated for each offering by the following generalized expression:

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41 MSA Professional Services, Inc. October 2019. *The Cost of Clean: Wisconsin Sewer User Charge Survey Report.*

42 Wisconsin Department of Natural Resources. *Wisconsin Public Water Systems 2020 Annual Drinking Water Report.* June 2021. https://dnr.wi.gov/files/pdf/pubs/DG/DG0045.pdf

$$\sum_{Measure=1}^{n} Units_{Measure} \times PV(Avoided\ Replacement\ Costs_{Measure})$$

Where PV indicates a present value function and $Avoided\ Replacement\ Costs$ refers to the value of avoided baseline measure replacements over the lifetime of the efficient measure.

For each efficient measure installed, the evaluation team attempted to identify a corresponding baseline measure from the Mid-Atlantic TRM because this TRM contains a study of purchase deferral benefits for lighting measures.[43] Where available, the evaluation team used the present value of purchase deferral benefits provided explicitly by the Mid-Atlantic TRM.

In cases where the Mid-Atlantic TRM did not provide purchase deferral benefit estimates or the efficient measure installed through a Focus on Energy offering was not an exact match, the evaluation team conducted research to identify the EUL (in life-hours and years) and the cost of the baseline measure indicated in the TRM. These two inputs were used to estimate benefits accrued from each avoided baseline replacement over the lifetime of the efficient measure, reduced by the Focus on Energy discount rate of 2%.

Non-Lighting

Purchase deferral benefits for non-lighting measures were estimated on an equipment maintenance cost deferral basis. The evaluation team leveraged EUL benchmarking data for the period of July 2020 to June 2021 to prioritize significant non-lighting measures based on the MMBtu saving contribution. For the identified measures, the evaluation team reviewed the Non-Energy Impacts study in the Mass Save TRM.[44] Benefits arising from equipment maintenance costs were reviewed for available measures.

Based on the aforementioned sources, purchase deferral benefits were estimated for the following non-lighting measures:

- Residential boilers
- Residential furnaces
- Residential thermostats
- Residential/retail ductless mini-split heat pumps

Based on the sourced data, the evaluation team estimated benefits accrued from avoided equipment maintenance cost over the lifetime of the non-lighting measure and applied the Focus on Energy discount rate of 2%.

Finally, the evaluation team scaled the calculated savings by the NTG ratio for each offering.

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43 Northeast Energy Efficiency Partnerships. October 2019. *Mid-Atlantic Technical Reference Manual, Version 9.* https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V9_Final_clean_wUpdateSummary%20-%20CT%20FORMAT.pdf

44 Non-Energy Benefits. *Massachusetts Technical Reference Manual.* May 2020. https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12190505

Property Values

Participating in energy efficiency programs can increase the value of a home and the associated property. Customers who participate in whole-home programs, such as Home Performance with ENERGY STAR, are most likely to see increases in property values.

In 2012, Cadmus completed a study for People Working Cooperatively (PWC), a provider of whole-home weatherization for low-income individuals in Cincinnati that researched the impact of low-income whole-home weatherization programs on home value.[45] Through this study, Cadmus found a $7,000 increase in property value for participants in the PWC program compared with nonparticipants with similar homes. A more recent study done in 2021 by Oak Ridge National Laboratory confirms that a whole-home weatherization project would increase property value for low-income customers.[46] Though these studies were specific to low-income customers, Cadmus believes the increase in property value can be applied to all customers who complete a whole-home weatherization project.

Many factors can impact home value, which makes it difficult to measure this benefit. To adjust for inflation from 2012, the net present value (NPV) of $7,000 is calculated as $8,923 per home. Therefore, for Wisconsin Focus on Energy, the evaluation team used an NPV benefit of $8,923 per whole-home participant (both Tier 1 and Tier 2) of Trade Ally Solutions (formerly Home Performance with ENERGY STAR Program).

Arrearages

Outstanding customer debt incurs a cost on the utility and the customer and includes the costs associated with financing (carrying costs, bad debt write-offs) shutoffs, reconnections, sending notices, and collecting debts. Low-income programs provide customers with the opportunity to reduce monthly bills, which in turn lowers the probability they will carry debt and, among those who do carry debt, helps reduce the overall total.

Several utilities have included the reduced arrearage costs associated with providing low-income program benefits in their societal tests. However, there does not appear to be a universally agreed-upon per-participant value associated with these benefits. Limited primary research is available, but what does exist is not recent. Nevertheless, the evaluation team reviewed two benchmarking analyses from

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45 Cadmus. December 2012. *PWC 2009 Ohio Program Services Evaluation Report.* Prepared for People Working Cooperatively. http://www.pwchomerepairs.org/Assets/PWC_2009_Evaluation_FIN/AL_DEC12.pdf

46 Oak Ridge National Laboratory. March 2021. *Addressing Non-Energy Impacts of Weatherization.* ORNL_SPR-2020_1840.pdf

the Skumatz Economic Research Associates, Inc., and Cadmus in 2010 and 2014,[47,48] which compiled several potential inputs related to the utility benefits associated with low-income programs.

As presented in Table I-5, the study found a typical arrearage-related carrying cost of $2.50 per participant, with an additional $1.75 cost associated with the paying of bad debt and $2.15 in total costs from shutoffs and reconnects, notices, and customer calls/collections. These direct arrearage costs sum to $6.40. An additional $13 per customer was also attributed to reduced low-income subsidy payments and discounts if the program was strictly low-income.

Table I-5. Typical Utility Costs Associated with Customer Debt

NEB Estimates from Multiple Weatherization Studies: Dollar and Percentage Analysis	Dollar NEB Values Range Low-High			Typical Value	Percent NEB Values Range Low-High			Typical Value	Notes
UTILITY PERSPECTIVE									
Payment-related									
Carrying cost on arrearages	$1.50	-	$4.00	$2.50	0.6%	-	4.4%	2.0%	Total arrearages $2-$100; $20-30 typical
Bad Debt Write-offs	$0.50	-	$3.75	$1.75	0.4%	-	2.0%	0.7%	
Reduced LI subsidy pymt/discounts	$3.00	-	$25.00	$13.00	3.9%	-	29.0%	16.4%	IF low income program
Shutoffs / Reconnects	$0.10	-	$3.65	$0.65	0.1%	-	4.4%	0.5%	
Notices	$0.05	-	$1.50	$0.60	0.1%	-	1.8%	0.9%	
Customer calls / collections	$0.40	-	$1.60	$0.90	0.2%	-	1.9%	0.6%	

Source: Skumatz Economic Research Associates, Inc. 2014. Non-Energy Benefits / Non-Energy Impacts (NEBS/NEIS) and Their Role & Values In Cost-Effectiveness Tests: State Of Maryland.

Therefore, for Focus on Energy, the evaluation team recommends that a per-participant value of $24.65 ($19.40 from 2014 adjusted for inflation) be applied to Tier 2 customers in the Insulation and Air Sealing offering in Trade Ally Solutions based on the results of the most direct benchmarking research available.

The evaluation team reviewed other, more recent evaluations of the impact of various program designs on the amount of debt participants carry. One of these programs, a prepayment program in the upper Midwest, showed evidence that customers were able to eliminate approximately $68 in total debt after participating in the program for at least one calendar year. However, key differences between that program design and the low-income offerings in Wisconsin make direct comparisons difficult. These differences include the targeting and/or opening of that offering to customers who are not low-income. That is, the total debt paid off through that prepayment program is not necessarily comparable to the debt held by strictly low-income customers in Focus on Energy's offerings in Wisconsin.

Interpreting Test Results

No single benefit/cost test can provide a comprehensive understanding of program performance or impacts in isolation. The results of tests that measure overall program cost-effectiveness, such as the

47 Skumatz Economic Research Associates, Inc. & The Cadmus Group. 2010. *Non Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analyses in California – Revised Report.*

48 Skumatz Economic Research Associates, Inc. 2014. *Non-Energy Benefits / Non-Energy Impacts (NEBS/NEIS) and Their Role & Values In Cost-Effectiveness Tests: State Of Maryland.*

modified TRC test, should be reviewed along with the results of other tests such as the UAT. Such a multi-perspective approach warrants a clear understanding of the tradeoffs among the tests.

Because of changes in avoided electric energy and natural gas costs and in emissions allowance prices for the current quadrennium (CY 2019-CY 2022), the cost-effectiveness results reported for Focus on Energy here are not directly comparable with results from the previous quadrennium (CY 2015-CY 2018). The changes to avoided costs tended to decrease the benefit/cost test results across all offerings when compared with the avoided costs used in the previous quadrennium.

In addition, changes in the calculation of incremental measure costs further reduce the comparability between quadrenniums, as the approach to measure cost calculation for many measures, including most custom measures, was revised between CY 2018, CY 2019, CY 2020 , CY 2021, and CY 2022. As with avoided costs, these changes often decreased the benefit/cost ratio at the portfolio level compared with the previous quadrennium. These externalities have an impact on offering and overall portfolio cost-effectiveness; however, they do not directly reflect the overall performance of Focus on Energy.

Energy Avoided Costs

The PSC established the methodology to estimate electric and natural gas avoided energy costs for the CY 2019-CY 2022 quadrennium under PSC docket 5-FE-101 (PSC REF#: 343909). The approach represents a continuation of the avoided cost methodology used for the CY 2015-CY 2018 quadrennium. The source for electric energy avoided costs are based on the Midcontinent Independent Transmission System Operator (MISO) forecasted locational marginal price (LMP), that is, the average of LMPs across Wisconsin nodes. Avoided natural gas costs are calculated based on Energy Information Administration 2018 Annual Energy Outlook forecasts of Henry Hub prices, adjusted using Wisconsin City Gate prices and retail prices.

Compared with the previous quadrennium, avoided costs calculated using updated price forecasts for the current quadrennium evaluation are lower by approximately 30%, on average.

The PSC established the step-by-step methodology to estimate avoided electric capacity costs for the CY 2019-CY 2022 quadrennium under PSC docket 5-FE-101 (PSC REF#: 390566).[49] The approach relies upon MISO-established Cost of New Entry (CONE) values as well as MISO Narrow Constrained Area net revenues to calculate avoided capacity costs. This methodology aligns with the PSC's decision for the CY 2019-CY 2022 quadrennium that, for the purposes of evaluating Focus on Energy, avoided capacity costs shall be based on the unit costs of a peaker plant.

The forecast model decreases the verified gross energy savings by the conventional attribution factor of NTG to derive net savings. The net savings are then increased by the line loss factor of 8% to account for avoided distribution losses. Table I-6 shows the assumptions for the CY 2018 through CY 2022 evaluation avoided costs used for the cost-effectiveness tests.

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49 Public Service Commission of Wisconsin. June 1, 2020. Quadrennial Planning Process III. Order PSC Docket 5-FE-101, REF#: 390566. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=390566

Table I-6. Avoided Costs

Avoided Cost	CY 2018	CY 2019	CY 2020	CY 2021	CY 2022
Electric Energy ($/kWh)[a]	$0.04747–$0.06871	$0.03093–$0.04878	$0.03093–$0.05015	$0.03093–$0.05291	$0.03093–$0.05429
Electric Capacity ($/kW year)	$130.26	$117.43–$174.17	$124.75–$176.99	$128.06–$179.83	$131.38–$182.67
Gas ($/therms)	$0.802–$1.278	$0.538–$0.764	$0.524–$0.777	$0.524–$0.785	$0.546–$0.797
Transmission and Distribution ($/kW year)	N/A	N/A	$66.34–$68.61	$66.40–$68.74	$66.47–$68.88
Avoided Cost Inflation	0%	0%	0%	0%	0%
Real Discount Rate	2%	2%	2%	2%	2%
Line Loss	8%	8%	8%	8%	8%

[a] The CY 2022 cost-effectiveness analyses used a time series that grows from $0.03093 to $0.05029 over 14 years in the forecast model.

Avoided Transmission and Distribution Costs

In its Final Decision of June 1, 2020, the PSC directed the Evaluation Work Group (EWG) to propose to the PSC a method for calculating avoided T&D costs to be used for the purpose of evaluating Focus on Energy (PSC REF#: 390566). In its Final Decision of March 10, 2021, the PSC approved the EWG's recommended methodology to estimate avoided electric T&D costs for the CY 2019CY 2022 quadrennium under PSC docket 5-FE-101 (PSC REF#: 406591), with the direction to incorporate avoided T&D costs into a parallel analysis of benefits achieved by Focus on Energy offerings in Quadrennial Planning Process III and to revisit avoided T&D costs in the Quadrennial Planning Process IV.

As stated in the commission order:[50]

> "In order to reduce the year-to-year variability of the costs, a four-year running average of the total miles and the annualized cost per mile per kW-Year are multiplied to get the average cost per kW-Year. For projecting values in future years, this approach escalates the most recent average Midcontinent Independent System Operating (MISO) Cost of New Entry (CONE) value by a growth factor that takes into account inflation and construction costs. The growth factor is calculated by taking the four-year average of construction cost growth as determined by the Wisconsin Department of Transportation in the Chained Fisher Construction Cost Index, and subtracting inflation (U.S. Bureau of Labor Statistics Consumer Price Index, Midwest Region[51]), over the same period."

50 Public Service Commission of Wisconsin. March 10, 2021. Quadrennial Planning Process III . Order PSC Docket 5-FE-101, REF#: 406591. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=406591.

51 Bureau of Labor Statistics Midwest CPI Summaries available here: Midwest CPI Summaries : Midwest Information Office : U.S. Bureau of Labor Statistics (bls.gov)

Following the approval for calculating avoided T&D costs, the evaluation team, using the method specified above, established estimated avoided T&D costs per kW for each year from 2018 to 2051. These values are presented in Table I-7 and are based on the PSC's Order in docket 5-FE-101.[52]

Avoided T&D costs are not applied to renewable projects at this time as insufficient primary data currently exist to verify any net reduction in T&D needs that would be associated with installing local generation, such as through photovoltaics (PVs). Given the current guidance on program design, solar PV projects cannot be scaled at more than 125% of the baseline consumption of a given location, which caps the potential for an increase in capacity required at the installation location.

However, such projects could, in theory, leave the requirements for T&D largely unaffected, as similar values for total kWh could be consumed or generated at that location. Therefore, until further research establishes a specific baseline for T&D impacts based on consumption data for those renewable projects, the evaluation team recommends not applying T&D benefits to any local renewable projects.

Table I-7. Calculated and Forecasted Avoided T&D Costs

Year	Avoided T&D Cost ($/kW-Yr)	Year	Avoided T&D Cost ($/kW-Yr)
2018	$66.22	2035	$67.62
2019	$66.28	2036	$67.73
2020	$66.34	2037	$67.85
2021	$66.40	2038	$67.97
2022	$66.47	2039	$68.09
2023	$66.54	2040	$68.21
2024	$66.61	2041	$68.34
2025	$66.69	2042	$68.47
2026	$66.76	2043	$68.61
2027	$66.85	2044	$68.74
2028	$66.93	2045	$68.88
2029	$67.02	2046	$69.03
2030	$67.11	2047	$69.17
2031	$67.21	2048	$69.32
2032	$67.31	2049	$69.48
2033	$67.41	2050	$69.63
2034	$67.51	2051	$69.79

[52] Public Service Commission of Wisconsin. January 20, 2021. Quadrennial Planning Process III . Order PSC Docket 5-FE-101, REF#: 403255. https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=403255

Emissions Benefits

The modified TRC benefit/cost calculations include the benefit of avoiding three air pollutants that are regulated under the Clean Air Act. These are carbon dioxide, sulfur dioxide, and nitrogen oxide. Determining the emissions benefits requires three key parameters: lifecycle net energy savings, emissions factors or a tool that uses emissions factors, and the dollar value of the displaced emissions.

Emissions factors are the rate at which the criteria pollutants are emitted per unit of energy generated and are most often expressed in tons of pollutant per energy unit. Electric is in tons/megawatt hour (MWh), and gas is in tons/thousand therms (MThm). The product of the emissions factor and the net energy savings is the total weight of air pollutant offset or avoided by the program.

The product of the total tonnage of pollutant saved and the dollar value of the reduced emissions per ton is, therefore, the avoided emissions benefit, as shown in this equation:

$$Value\ of\ Avoided\ Emissions = [Net\ Saved\ Energy\ x\ Emissions\ Factor\ x\ Value\ of\ Emissions\ Allowance]$$

For CY 2022, the evaluation team assessed the electric emissions benefits for Focus on Energy using AVERT, a tool developed by the EPA to calculate avoided emissions from renewable energy and energy efficiency programs. AVERT is a spreadsheet-based model that uses historical hourly generation and emissions data to determine the individual power plants that are likely to be displaced by energy efficiency or renewable energy during each hour of the year.

To use AVERT to calculate electric emissions benefits, the lifecycle net electric savings for Focus on Energy needed to be attributed to an AVERT region. Previously, Wisconsin was allocated to two regions; however, in 2020 the EPA revised its regions, and now Wisconsin falls into a single region.

Savings for Focus on Energy offerings are run through a region-specific version of AVERT to calculate the electric emissions benefits per offering. AVERT uses a model from the previous year to compare the electricity generation avoided by the Focus on Energy offerings during each hour of the year with the hourly generation information to determine the quantity of emissions displaced.

Table I-8 lists the gas emissions factor and allowance prices. For 2022, the electric emissions scalar was 914.22 tons of carbon dioxide per GWh. Note that this can be used to estimate avoided tons of carbon from electric savings; however, it is not exact, will not apply for any other years or regions, and will vary in results based on input GWh.

Table I-8. Emissions Factors and Allowance Price

Service Fuel Type	Carbon Dioxide	Nitrogen Oxide	Sulfur Dioxide
Gas Emissions Factor (Tons/MThm)	5.85	N/A	N/A
Allowance Price ($/Ton)	$15	$7.50	$2

For CY 2022, as in previous years, the evaluation team continued to obtain allowance prices for nitrogen oxide and sulfur dioxide emissions from the EPA's Cross State Air Pollution Rule, most recently updated in 2018.[53] The team used the carbon dioxide emissions price in the PSC's Order, docket 5-FE-101, PSC REF#: 343909, which states, "The Commission finds it reasonable for Focus cost-effectiveness tests to continue valuing avoided carbon dioxide emissions using a market-based value of $15.00 per ton."[54]

The natural gas emissions factor has remained constant since the CY 2011 evaluation report and is derived from a best practice greenhouse gas inventory method developed by the California Energy Commission.[55]

Table I-9 lists the total avoided emissions by gas type in tons.

Table I-9. Total Emissions Benefits by Gas Type

Year	Carbon Dioxide	Nitrogen Oxide	Sulfur Oxide
CY 2019 Tons of Emissions Avoided	7,915,240	3,772	5,336
CY 2020 Tons of Emissions Avoided	7,761,679	3,921	5,183
CY 2021 Tons of Emissions Avoided	7,323,422	3,408	4,550
CY 2022 Tons of Emissions Avoided	6,241,182	3,003	4,008

Table I-10 lists the emissions benefits for all programs by segment.

Table I-10. Total Emissions Benefits by Segment

Year	Residential	Nonresidential	Midstream [a]	Rural	Total [b]
CY 2019 Emissions Benefits	$25,422,131	$91,289,103	N/A	$2,092,656	**$118,803,890**
CY 2020 Emissions Benefits	$26,004,128	$89,940,588	$520,240	$7,006,188	**$123,471,144**
CY 2021 Emissions Benefits	$20,085,064	$82,221,328	$1,124,349	$6,455,256	**$109,885,997**
CY 2022 Emissions Benefits	$24,980,488	$59,520,395	$737,740	$8,409,650	**$93,649,181**

[a] The Midstream Solution incents both residential and nonresidential measures through a distributor-based delivery approach.
[b] Sector subtotals may not sum due to overlapping programs in rural and renewable categories.

53 U.S. Environmental Protection Agency. December 14, 2018. "Cross-State Air Pollution Rule." https://www.epa.gov/csapr

54 Public Service Commission of Wisconsin. June 6, 2018. Quadrennial Planning Process III. Order PSC Docket 5-FE-101, REF#: 343909. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=343909

55 California Air Resources Board. 2019. *California Greenhouse Gas Emissions for 2000 to 2017.* https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf

Offering Costs

The CY 2022 offering costs were provided to the evaluation team from Focus on Energy's contract fiscal agent, the accounting firm Wipfli, and represent all costs associated with running the efficiency offerings (including administration and delivery costs). Note that incentive costs are not included as TRC costs because they are deemed transfer payments, which is consistent with industry guidelines defining the TRC test. Incentive costs, however, are used for other tests such as the UAT.

Incremental Costs

The gross incremental costs are the additional costs incurred by participants as a result of purchasing efficient equipment over and above a baseline nonqualified product. The evaluation team derived the gross incremental cost values used in this CY 2022 evaluation from the incremental cost study conducted by the administrator, implementers, and evaluation team. This study established up-to-date incremental costs for all measures based on the best available data, including historical Focus on Energy program data and independent research from other state programs.

Lost Revenue

To calculate the RIM test, the evaluation team determined an average value in lost revenue attributable to reductions in energy consumption due to program behavior. The assumptions used for this test are shown in Table I-11.

Table I-11. Lost Revenue Inputs

	Weighted Average Rate ($/kWh or Therms)	Annual Net Lost Revenue	Average Measure Life	Total Lost Revenue
Residential Rate (kWh)	$0.1217	$16,375,079	13	$185,968,163
Nonresidential Rate (kWh)	$0.0655	$17,973,196	13	$204,417,078
Midstream Rate (kWh)	$0.0748	$133,375	14	$1,647,705
Residential Rate (Therms)	$0.5540	$2,433,263	17	$33,987,928
Nonresidential Rate (Therms)	$0.3860	$3,185,052	13	$36,788,104
Midstream Rate (Therms)	$0.4298	$96,949	14	$1,206,764

Cost-Effectiveness Results by Test

Table I-12 presents the inputs and results from the modified TRC test for the Focus on Energy CY 2022 energy efficiency and renewable resource portfolio. Application of the modified TRC test with T&D benefits showed that net statewide benefits to residents, businesses, and Focus on Energy from the CY 2022 offerings were $585,868,783.

Not including T&D, the benefits from the residential offerings were 1.43 times greater than the costs, while the benefits from the nonresidential offering outweighed the costs by a factor of 2.66. Benefits from the Midstream offering outweighed costs by a factor of 1.31. The table also presents the results of the modified TRC ratio but with the inclusion of T&D avoided costs. Adding these benefits increases the overall modified TRC ratio to 2.36 from 2.15.

Table I-12. CY 2022 Sector-Level and Overall Results, Modified Total Resource Cost Test

	Residential	Nonresidential	Midstream	Total
Administrative Costs	$1,300,424	$1,459,415	$37,339	$2,797,178
Delivery Costs	$13,019,271	$19,737,068	$373,822	$33,130,161
Incremental Measure Costs	$85,398,671	$124,229,177	$3,058,802	$212,686,651
Total TRC Costs	**$99,718,367**	**$145,425,660**	**$3,469,963**	**$248,613,990**
Electric Benefits	$83,031,124	$251,277,866	$1,705,596	$336,014,587
Gas Benefits	$33,735,123	$67,984,246	$2,087,676	$103,807,046
Emissions Benefits	$25,336,975	$67,574,466	$737,740	$93,649,181
T&D Benefits	$12,287,341	$39,846,648	$248,592	$52,382,582
Total TRC Benefits	**$154,390,564**	**$426,683,227**	**$4,779,605**	**$585,853,396**
TRC Benefits Minus Costs	**$54,672,197**	**$281,257,567**	**$1,309,642**	**$337,239,405**
TRC Benefit/Cost Ratio	**1.55**	**2.93**	**1.38**	**2.36**
TRC Benefit/Cost Ratio without T&D Benefits	**1.43**	**2.66**	**1.31**	**2.15**

Table I-13 presents the inputs and results from the expanded TRC test for the Focus on Energy CY 2022 energy efficiency and renewable resource portfolio. The expanded TRC test includes economic benefits from the portfolio.

Table I-13. CY 2022 Overall Results, Expanded Total Resource Cost Test

	Total
Administrative Costs	$2,797,178
Delivery Costs	$33,130,161
Incremental Measure Costs	$212,686,651
Total TRC Costs	**$248,613,990**
Electric Benefits	$336,014,587
Gas Benefits	$103,807,046
T&D Benefits	$52,382,582
Emissions Benefits	$93,649,181
Economic Benefits	$546,259,320
Total TRC Benefits	**$1,132,112,716**
TRC Benefits Minus Costs	**$883,498,726**
TRC Benefit/Cost Ratio	**4.55**
TRC Benefit/Cost Ratio without T&D Benefits	**4.34**

Table I-14 presents the inputs and results from the UAT for the CY 2022 Focus on Energy portfolio. With T&D benefits incorporated, the benefits from the residential offerings were 3.35 times greater than the costs, while the benefits from the nonresidential offerings outweighed the costs by a factor of 7.24.

Table I-14. CY 2022 Overall Results, Utility Administrator Cost Test

	Residential	Nonresidential	Midstream	Total
Incentive Costs	$24,248,627	$28,422,690	$696,250	$53,367,567
Administrative Costs	$1,300,424	$1,459,415	$37,339	$2,797,178
Delivery Costs	$13,019,271	$19,737,068	$373,822	$33,130,161
Total UAT Costs	**$38,568,322**	**$49,619,173**	**$1,107,411**	**$89,294,906**
Electric Benefits	$83,031,124	$251,277,866	$1,705,596	$336,014,587
Gas Benefits	$33,735,123	$67,984,246	$2,087,676	$103,807,046
T&D Benefits	$12,287,341	$39,846,648	$248,592	$52,382,582
Total UAT Benefits	**$129,053,589**	**$359,108,761**	**$4,041,864**	**$492,204,214**
UAT Benefits Minus Costs	**$90,485,267**	**$309,489,588**	**$2,934,454**	**$402,909,308**
UAT Benefit/Cost Ratio	**3.35**	**7.24**	**3.65**	**5.51**
UAT Benefit/Cost Ratio without T&D Benefits	**3.03**	**6.43**	**3.43**	**4.93**

Table I-15 shows the inputs and results from the RIM test for CY 2022 energy efficiency and renewable resource offerings. As expected, estimated overall benefit/cost value from the RIM test is less than 1. When interpreted within the context of the UAT test results, these findings indicate that, although annual Focus on Energy activities will probably induce theoretical upward pressure on future energy rates, total ratepayer energy costs will go down.

Table I-15. CY 2022 Sector-Level and Overall Results, Ratepayer Impact Measure Test

	Residential	Nonresidential	Midstream	Total
Incentive Costs	$24,248,627	$28,422,690	$696,250	$53,367,567
Electric Lost Revenues	$207,262,425	$216,606,350	$1,647,705	$425,516,480
Gas Lost Revenues	$33,987,928	$36,788,104	$1,206,764	$71,982,797
Administrative Costs	$1,300,424	$1,459,415	$37,339	$2,797,178
Delivery Costs	$13,019,271	$19,737,068	$373,822	$33,130,161
Total RIM Costs	**$279,818,675**	**$303,013,627**	**$3,961,881**	**$586,794,183**
Electric Benefits	$83,031,124	$251,277,866	$1,705,596	$336,014,587
Gas Benefits	$33,735,123	$67,984,246	$2,087,676	$103,807,046
Total RIM Benefits	**$116,766,247**	**$319,262,113**	**$3,793,272**	$439,821,632
RIM Benefits Minus Costs	**$(163,052,428)**	**$16,248,485**	**$(168,608)**	**$(146,972,551)**
RIM Benefit/Cost Ratio[a]	**0.42**	**1.05**	**0.96**	**0.75**

[a] For the CY 2022 cost-effectiveness analysis, the lost revenue portion of RIM test assumes a fixed utility rate that does not escalate over time; avoided energy costs are escalated on a yearly basis resulting in greater benefits than costs for the nonresidential portfolio.

Table I-16 shows the inputs and results from the societal test for CY 2022 energy efficiency and renewable resource offerings. As expected, estimated overall benefit/cost value from the societal test is the highest of all the tests excluding the UAT, including the same costs as the modified TRC, with additional non-energy benefits. When interpreted within the context of the modified TRC test results, these findings suggest that Focus on Energy activities provide substantial additional benefits, generating additional value in terms of personal health cost savings, water savings, lighting purchase deferrals, property values, and arrearage repayment assistance. Including T&D benefits, the benefits from the residential offerings were 2.46 times greater than the costs, while the benefits from the nonresidential offerings outweighed the costs by a factor of 3.28.

Table I-16. CY 2022 Sector-Level and Overall Results, Societal Test

	Residential	Nonresidential	Midstream	Total
Administrative Costs	$1,300,424	$1,459,415	$37,339	$2,797,178
Delivery Costs	$13,019,271	$19,737,068	$373,822	$33,130,161
Incremental Measure Costs	$85,398,671	$124,229,177	$3,058,802	$212,686,651
Total Non-Incentive Costs	**$99,718,367**	**$145,425,660**	**$3,469,963**	**$248,613,990**
Electric Benefits	$83,031,124	$251,277,866	$1,705,596	$336,014,587
Gas Benefits	$33,735,123	$67,984,246	$2,087,676	$103,807,046
Emissions Benefits	$25,336,975	$67,574,466	$737,740	$93,649,181
T&D Benefits	$12,287,341	$39,846,648	$248,592	$52,382,582
Health Benefits	$16,702,351	$33,602,891	$221,752	$50,526,994
Water Benefits	$855,946	$9,507,256	$103,927	$10,467,129
Purchase Deferral Benefits	$57,756,345	$7,503,642	$361,472	$65,621,460
Other Non-Energy Benefits [a]	$15,264,024	$-	$-	$15,264,024
Economic Benefits	N/A	N/A	N/A	$546,259,320
Total SOC Benefits	**$244,969,231**	**$477,297,016**	**$5,466,756**	**$1,273,992,322**
SOC Benefits Minus Costs	**$145,250,864**	**$331,871,356**	**$1,996,792**	**$1,025,378,332**
SOC Ratio	**2.46**	**3.28**	**1.58**	**5.12**
SOC Ratio without T&D Benefits	**2.33**	**3.01**	**1.50**	**4.91**

[a] Includes Property Values and Arrearages

Cost-Effectiveness Results by Offering

Table I-17 and Table I-18 provide the sector-level and overall results of the cost-effectiveness analysis shown by core efficiency offerings, rural offerings, and renewables. In CY 2022, cost-effectiveness is presented in more detail because of the presence of rural and renewable programs. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. Table I-19 provides UAT test results. Table I-20 provides RIM test results. Table I-21 provides societal test results.

Table I-17. CY 2022 Overall Cost-Effectiveness Analysis with Portfolio Breakout

<table>
<tr><th colspan="2">Focus on Energy Benefits and Costs</th><th>Portfolio Breakout</th><th>Core Efficiency</th><th>Rural</th><th>Renewables</th></tr>
<tr><td>Incentives</td><td>$53,367,567</td><td rowspan="3"></td><td>$44,886,131</td><td>$4,084,339</td><td>$4,460,461</td></tr>
<tr><td>Modified TRC Benefits ($ millions)</td><td>$585,853,396</td><td>$462,704,477</td><td>$51,369,364</td><td>$66,999,950</td></tr>
<tr><td>Modified TRC Costs ($ millions)</td><td>$248,613,990</td><td>$182,229,919</td><td>$13,991,552</td><td>$49,404,937</td></tr>
<tr><td rowspan="4">Portfolio TRC Ratio</td><td rowspan="4">2.36</td><td>Alone</td><td>2.54</td><td>3.67</td><td>1.36</td></tr>
<tr><td colspan="2">With Core</td><td>2.62</td><td>2.29</td></tr>
<tr><td colspan="3">With Core and Rural</td><td>2.37</td></tr>
<tr><td colspan="3">With Core & Rural & Renewables</td><td>2.36</td></tr>
</table>

Table I-18. CY 2022 Overall with Renewables Separate Cost-Effectiveness Analysis, Modified Total Resource Cost Test

	Residential	Nonresidential	Midstream	Renewables	Total
Administrative Costs	$1,181,238	$1,344,500	$37,339	$234,102	$2,797,178
Delivery Costs	$11,826,031	$18,182,952	$373,822	$2,747,356	$33,130,161
Incremental Measure Costs	$54,659,905	$108,544,464	$3,058,802	$46,423,479	$212,686,651
Total Non-Incentive Costs	**$67,667,175**	**$128,071,915**	**$3,469,963**	**$49,404,937**	**$248,613,990**
Electric Benefits	$59,379,444	$226,288,311	$1,705,596	$48,641,236	$336,014,587
Gas Benefits	$33,735,123	$67,981,083	$2,087,676	$3,163	$103,807,046
Emissions Benefits	$21,666,072	$63,671,512	$737,740	$7,573,857	$93,649,181
T&D Benefits	$7,031,358	$34,320,937	$248,592	$10,781,694	$52,382,582
Total TRC Benefits	**$121,811,997**	**$392,261,844**	**$4,779,605**	**$66,999,950**	**$585,853,396**
TRC Benefits Minus Costs	**$54,144,823**	**$264,189,928**	**$1,309,642**	**$17,595,013**	**$337,239,405**
TRC Ratio	**1.80**	**3.06**	**1.38**	**1.36**	**2.36**
TRC Ratio without T&D Benefits	**1.70**	**2.79**	**1.31**	**1.14**	**2.15**

Table I-19. CY 2022 Overall with Renewables Separate Cost-Effectiveness Analysis, Utility Administrator Cost Test

	Residential	Nonresidential	Midstream	Renewables	Total
Incentive Costs	$22,026,196	$26,184,660	$696,250	$4,460,461	$53,367,567
Administrative Costs	$1,181,238	$1,344,500	$37,339	$234,102	$2,797,178
Delivery Costs	$11,826,031	$18,182,952	$373,822	$2,747,356	$33,130,161
Total Non-Incentive Costs	**$35,033,465**	**$45,712,111**	**$1,107,411**	**$7,441,919**	**$89,294,906**
Electric Benefits	$59,379,444	$226,288,311	$1,705,596	$48,641,236	$336,014,587
Gas Benefits	$33,735,123	$67,984,246	$2,087,676	$3,163	$103,810,209
T&D Benefits	$7,031,358	$34,320,937	$248,592	$10,781,694	$52,382,582
Total UAT Benefits	**$100,145,925**	**$328,593,495**	**$4,041,864**	**$59,426,093**	**$492,207,377**
UAT Benefits Minus Costs	**$65,112,460**	**$282,881,384**	**$2,934,454**	**$51,984,174**	**$402,912,471**
UAT Ratio	**2.86**	**7.19**	**3.65**	**7.99**	**5.51**
UAT Ratio without T&D Benefits	**2.66**	**6.44**	**3.43**	**6.54**	**4.93**

Table I-20. CY 2022 Overall with Renewables Separate Cost-Effectiveness Analysis, Ratepayer Impact Measure Test

	Residential	Nonresidential	Midstream	Renewables	Total
Incentive Costs	$22,026,196	$26,184,660	$696,250.00	$4,460,461	$53,367,567
Electric Lost Revenues	$185,968,163	$204,417,078	$1,647,705	$33,483,534	$425,516,480
Gas Lost Revenues	$33,987,928	$36,788,104	$1,206,764	$-	$71,982,797
Administrative Costs	$1,181,238	$1,344,500	$37,339	$234,102	$2,797,178
Delivery Costs	$11,826,031	$18,182,952	$373,822	$2,747,356	$33,130,161
Total RIM Costs	**$254,989,556**	**$286,917,293**	**$3,961,881**	**$40,925,453**	**$586,794,183**
Electric Benefits	$59,379,444	$226,288,311	$1,705,596.27	$48,641,236	$336,014,587
Gas Benefits	$33,735,123	$67,981,083	$2,087,676.20	$3,163	$103,807,046
Total RIM Benefits	**$93,114,567**	$294,269,394	$3,793,272	$48,644,399	$439,821,632
RIM Benefits Minus Costs	**$(161,874,989)**	**$7,352,101**	**$(168,608)**	**$7,718,946**	**$(146,972,551)**
RIM B/C Ratio	**0.37**	**1.03**	**0.96**	**1.19**	**0.75**

Table I-21. Overall with Renewables Separate Cost-Effectiveness Analysis, Societal Test

	Residential	Nonresidential	Midstream	Renewables	Total
Incentive Costs	$22,026,196	$26,184,660	$696,250	$4,460,461	$53,367,567
Administrative Costs	$11,826,031	$18,182,952	$373,822	$2,747,356	$33,130,161
Delivery Costs	$1,181,238	$1,344,500	$37,339	$234,102	$2,797,178
Incremental Measure Costs	$54,659,905	$108,544,464	$3,058,802	$46,423,479	$212,686,651
Total Non-Incentive Costs	**$67,667,175**	**$128,071,915**	**$3,469,963**	**$49,404,937**	**$248,613,990**
Electric Benefits	$59,379,444	$226,288,311	$1,705,596	$48,641,236	$336,014,587
Gas Benefits	$33,735,123	$67,981,083	$2,087,676	$3,163	$103,807,046
Emissions Benefits	$21,666,072	$63,671,512	$737,740	$7,573,857	$93,649,181
T&D Benefits	$7,031,358	$34,320,937	$248,592	$10,781,694	$52,382,582
Health Benefits	$15,371,172	$32,186,855	$221,752	$2,747,215	$50,526,994
Water Benefits	$855,946	$9,507,256	$103,927	$-	$10,467,129
Purchase Deferral	$57,756,345	$7,503,642	$361,472	$-	$65,621,460
Other Non Energy Benefits [a]	$15,264,024	$-	$-	$-	$15,264,024
Economic Benefits	N/A	N/A	N/A	N/A	$546,259,320
Total SOC Benefits	**$211,059,484**	**$441,459,597**	**$5,466,756**	**$69,747,165**	**$1,273,992,322**
SOC Benefits Minus Costs	**$143,392,310**	**$313,387,681**	**$1,996,792**	**$20,342,228**	**$1,025,378,332**
SOC Ratio	**3.12**	**3.45**	**1.58**	**1.41**	**5.12**
SOC Ratio without T&D Benefits	**3.02**	**3.18**	**1.50**	**1.19**	**4.91**

[a] Includes property values and arrearages

Table I-22 provides the residential offerings cost-effectiveness analysis. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. The values provided are exclusive of renewable and rural offerings.

Table I-22. CY 2022 Residential and Midstream Offerings Cost-Effectiveness Analysis

	Direct to Customer				Trade Ally Solutions			Residential New Construction	Midstream
	Online Marketplace	Packs	Retail	Income Qualified	Building Shell	Heating and Cooling	Tribes		
Incentive Costs	$2,616,696	$3,358,189	$3,103,998	$3,369,443	$2,097,988	$4,800,945	$8,700	$2,374,498	$696,250
Administrative Costs	$140,330	$180,096	$166,464	$180,699	$112,513	$257,469	$467	$127,341	$37,339
Delivery Costs	$1,404,924	$1,803,037	$1,666,560	$1,809,080	$1,126,426	$2,577,664	$4,671	$1,274,886	$373,822
Incremental Measure Costs	$6,248,811	$3,911,422	$1,097,853	$8,484,678	$9,520,362	$25,253,265	$35,679	$0	$3,058,802
Total Non-Incentive Costs	**$7,794,064**	**$5,894,554**	**$2,930,877**	**$10,474,457**	**$10,759,300**	**$28,088,398**	**$40,817**	**$1,402,228**	**$3,469,963**
Electric Benefits (kWh)	$4,727,819	$7,070,824	$2,593,493	$24,504,699	$2,940,325	$1,127,654	$3,241	$0	$1,130,670
Electric Benefits (kW)	$156,698	$3,106,682	$1,184,114	$8,117,921	$2,895,938	$299,595	$0	$0	$574,927
T&D Benefits	$73,909	$1,405,014	$560,818	$3,635,526	$1,166,946	$126,319	$0	$0	$248,592
Gas Benefits	$4,829,351	$9,340,092	$409,635	$0	$4,372,184	$13,351,805	$31,231	$372,268	$2,087,676
Emissions Benefits	$2,550,371	$4,148,578	$1,075,227	$9,153,027	$1,749,946	$2,562,427	$6,226	$63,782	$737,740
Total TRC Benefits	**$12,338,148**	**$25,071,190**	**$5,823,287**	**$45,411,174**	**$13,125,340**	**$17,467,800**	**$40,698**	**$436,050**	**$4,779,605**
TRC Benefits Minus Costs	**$4,544,084**	**$19,176,636**	**$2,892,410**	**$34,936,717**	**$2,366,040**	**($10,620,598)**	**($119)**	**($966,177)**	**$1,309,642**
TRC Ratio Benefits	**1.58**	**4.25**	**1.99**	**4.34**	**1.22**	**0.62**	**1.00**	**0.31**	**1.38**
TRC Ratio without T&D	**1.57**	**4.01**	**1.80**	**3.99**	**1.11**	**0.62**	**1.00**	**0.31**	**1.31**

Table I-23 provides nonresidential offerings cost-effectiveness analysis. Incentive costs are provided below, but they are not included in the TRC calculation. The TRC ratio equals the total TRC benefits divided by total non-incentive costs. The values provided are exclusive of rural and renewable programs.

Table I-23. CY 2022 Nonresidential Offerings Cost-Effectiveness Analysis

	Business and Industry		Business New Construction		Schools and Government		Pilots	Direct to Customer[a]
	Commercial and Industrial	Large Industrial	Design Assistance	Virtual Commissioning	School	Government	Virtual Commissioning	Packs
Incentive Costs	$6,449,271	$5,525,622	$4,691,993	$843,878	$3,196,237	$1,867,068	$162,803	$49,138
Administrative Costs	$331,150	$283,723	$240,919	$56,654	$164,117	$95,868	$8,359	$2,523
Delivery Costs	$4,478,453	$3,837,061	$3,258,178	$766,191	$2,219,507	$1,296,515	$113,053	$34,122
Incremental Measure Costs	$28,452,555	$21,295,613	$27,339,753	$3,600,530	$10,171,906	$8,749,515	$0	$0
Total Non-Incentive Costs	**$33,262,158**	**$25,416,396**	**$30,838,850**	**$4,423,376**	**$12,555,529**	**$10,141,898**	**$121,412**	**$36,645**
Electric Benefits (kWh)	$38,185,051	$32,512,270	$27,456,802	$8,550,579	$8,961,933	$13,565,235	$97,173	$83,571
Electric Benefits (kW)	$20,750,417	$16,964,348	$16,300,403	$5,383,351	$5,591,651	$6,278,598	$0	$57,267
T&D Benefits	$8,959,573	$7,295,844	$6,788,920	$2,297,719	$2,433,197	$2,710,932	$0	$26,246
Gas Benefits	$16,842,011	$18,502,844	$9,866,068	$4,265,321	$8,532,133	$2,836,592	$0	$0
Emissions Benefits	$16,624,196	$14,737,524	$11,296,942	$3,765,565	$4,646,375	$5,403,658	$53,871	$0
Total TRC Benefits	**$101,361,249**	**$90,012,830**	**$71,709,134**	**$24,262,533**	**$30,165,289**	**$30,795,015**	**$151,044**	**$167,085**
TRC Benefits Minus Costs	**$68,099,091**	**$64,596,434**	**$40,870,284**	**$19,839,158**	**$17,609,760**	**$20,653,117**	**$29,632**	**$130,440**
TRC Ratio	**3.05**	**3.54**	**2.33**	**5.49**	**2.40**	**3.04**	**1.24**	**4.56**
TRC Ratio without T&D Benefits	**2.78**	**3.25**	**2.11**	**4.97**	**2.21**	**2.77**	**1.24**	**3.84**

[a] Direct to Customer Packs were funded under the residential program, but were designated for and sent to business customers.

Table I-24 provides results of the cost-effectiveness analysis for offerings targeted to customers in rural areas. The values provided are exclusive of renewable programs.

Table I-24. CY 2022 Rural Non Renewable Cost-Effectiveness Analysis

	Direct to Customer		Schools & Government		Business and Industry
	Income Qualified	Pop-Up Retail	Tribes	Agribusiness	Non-Agriculture Rural
Incentive Costs	$99,853	$131,386	$8,943	$2,038,000	$1,046,543
Administrative Costs	$5,355	$7,046	$459	$104,645	$53,737
Delivery Costs	$53,612	$70,542	$6,210	$1,415,212	$726,732
Incremental Measure Costs	$0	$107,835	$20,461	$7,343,233	$3,594,090
Total Non-Incentive Costs	**$58,967**	**$185,423**	**$27,131**	**$8,863,091**	**$4,374,559**
Electric Benefits (kWh)	$276,594	$237,106	$17,494	$14,386,343	$4,386,341
Electric Benefits (kW)	$56,045	$80,695	$12,053	$7,748,772	$2,262,559
T&D Benefits	$25,313	$37,512	$5,280	$3,300,159	$976,645
Gas Benefits	$830,663	$197,894	$5,167	$3,065,024	$5,051,654
Emissions Benefits	$234,198	$122,290	$7,281	$5,656,040	$2,390,241
Total TRC Benefits	**$1,422,814**	**$675,497**	**$47,276**	**$34,156,338**	**$15,067,440**
TRC Benefits Minus Costs	**$1,363,847**	**$490,073**	**$20,145**	**$25,293,247**	**$10,692,881**
TRC Ratio	**24.13**	**3.64**	**1.74**	**3.85**	**3.44**
TRC Ratio without T&D Benefits	**23.70**	**3.44**	**1.55**	**3.48**	**3.22**

Cost-Effectiveness Results for Renewables

Table I-25 lists the CY 2019, CY 2020, CY 2021 and CY 2022 cost-effectiveness results, with renewables excluded and with renewables included. CY 2022 values include T&D benefits.

Table I-25. Cost-Effectiveness Results for Focus on Energy Portfolio

Calendar Year	Residential	Nonresidential	Midstream	Renewables	Total
CY 2019: Modified TRC Test Result with Renewables	1.70	2.99	N/A	N/A	**2.58**
CY 2019: Modified TRC Test Result Renewables Excluded	1.79	3.11	N/A	1.51	**2.58**
CY 2020: Modified TRC Test Result with Renewables	1.70	2.78	1.45	N/A	**2.43**
CY 2020: Modified TRC Test Result Renewables Excluded	2.07	2.86	1.45	1.24	**2.43**
CY 2021: Modified TRC Test Result with Renewables	1.49	2.78	1.52	N/A	**2.35**
CY 2021: Modified TRC Test Result Renewables Excluded	1.65	2.82	1.52	1.48	**2.35**
CY 2022: Modified TRC Test Result with Renewables	1.55	2.93	1.38	N/A	**2.36**
CY 2022: Modified TRC Test Result Renewables Excluded	1.80	3.06	1.38	1.36	**2.36**

Appendix J. Wisconsin Wastewater Treatment Plant Market Assessment

Introduction

The evaluation team conducted a market assessment of Wisconsin's wastewater treatment plants (WWTP) by analyzing response data from the Compliance Maintenance Annual Report (CMAR) compiled between 2016 and 2020. The Wisconsin Department of Natural Resources (DNR) developed the CMAR to collect and compile self-assessment forms from owners of publicly and privately owned domestic WWTPs. These data describe the plants' wastewater management activities, physical conditions, energy use for the calendar year, and saturation of energy-efficient equipment to "promote an owner's awareness and responsibility for wastewater conveyance and treatment needs."[56]

A follow-up survey of WWTP owners and facility managers who provided their CMAR reports to the DNR was developed and administered by the evaluation team between January and February 2023. The market assessment provides insight into the penetration and saturation of energy-efficient equipment and processes of WWTPs, barriers that facility managers and owners see to adopting energy-efficient equipment, energy-efficient decision-making practices of facility managers and owners, and facility and owner awareness of current Focus on Energy offerings and interest in potential new offerings.

Analysis of CMAR Data

This section describes the analysis of compiled CMAR survey data from 2016 to 2020. The analysis included a review of raw data survey responses from WWTP facility managers and owners who answered questions related to the average daily flow in millions of gallons per day (MGD), the presence of energy efficiency equipment, code and testing compliance, plant assessment information, and energy usage.

Plants are grouped by output size in MGD, from 0 MGD to 0.05 MGD as the smallest output category to >1 MGD as the largest. In total, 618 plants (out of approximately 1,000 plants in Wisconsin) responded to the CMAR survey between 2016 and 2020. Two-thirds (n=417) of these plants had an MGD of 0.25 or less. Only 14% (n=89) had an MGD over 1. Table J-1 shows the number of CMAR responses by plant size and the percentage of plants represented in the plant category.

[56] Wisconsin Department of Natural Resources. n.d. "Compliance Maintenance Annual Report (CMAR) | Wastewater Treatment Works Compliance Maintenance Program | Wisconsin DNR." https://dnr.wisconsin.gov/topic/Wastewater/CMAR.

Table J-1. CMAR Survey Responses by Plant Size

Plant Size	Number of Plants Responding to CMAR Survey	Percentage of Total Responding Plants
0-0.05 MGD	206	33%
0.05-0.25 MGD	211	34%
0.25-1 MGD	112	18%
>1 MGD	89	14%
Total	**618**	**100%**

Treatment Plant Equipment Saturation

The CMAR survey asked WWTP respondents about the installation and usage of specific WWTP equipment at their plants (Table J-2).

Table J-2. WWTP Equipment Options in CMAR

Aerobic Digestion	Anaerobic Digestion
Biological Phosphorus Removal	Coarse Bubble Diffusers
Dissolved Oxygen Monitoring and Aeration Control	Effluent Pumping
Fine Bubble Diffusers	Influent Pumping
Mechanical Sludge Processing	Nitrification
Supervisory Control and Data Acquisition (SCADA) System	Ultraviolet (UV) Disinfection
Variable Speed Drives (VSD)	Other (Optional)

Source: 2020 CMAR Data. Question 7.2.1 "Indicate equipment and practices utilized at your treatment facility (Check all that apply)."

Equipment saturation increased with the capacity of the plants, with the highest saturation found in plants with a capacity of >1 MGD.

Across all plant sizes, supervisory control and data acquisition (SCADA) systems were installed in 56% of all plants, 97% of plants with a capacity of >1 MGD, and 90% of plants with a capacity of 0.25 MGD to 1 MGD. SCADA systems are used as automated monitoring controls that allow plant operators to view real-time data. Similarly, variable speed drives (VSDs), which increase efficiency in pumps, compressor systems, and motors, were reported in 56% of all plant sizes combined and found in 96% of facilities with an MGD >1 MGD and 90% of facilities with a capacity of 0.25 MGD to 1 MGD.

SCADA and VSD equipment had notably lower saturation in smaller facilities, with only about half of the plants with a capacity of 0.05 MGD to 0.25 MGD using both systems and about one-fifth of plants with a capacity of 0 MGD to 0.05 MGD.

Forty-seven percent of all plants surveyed contained an aerobic digester. Plants with a capacity >1 MGD had the lowest saturation of aerobic digester systems (27%), making these systems the least installed type of equipment across >1 MGD plants. Larger plants are more likely to implement anaerobic digestion systems that cover both solid and liquid disposals. These systems are used to separate and recycle liquids then follow a separate process for solid disposal. Smaller plants, however, focus on aerobic digesters converting bio solids into liquid disposal.

Over 50% of all survey respondents reported their plant had a SCADA system installed (n=346) and VSD installed (n=328) installed. Respondents reported saturation of between 30% to 49% for other measures:

- Aerobic digestion (n=290)
- Dissolved oxygen monitoring and aeration control (n=278)
- Fine bubble diffuser saturation (n=272)
- UV disinfection (n=241)
- Effluent pumping (n=198)

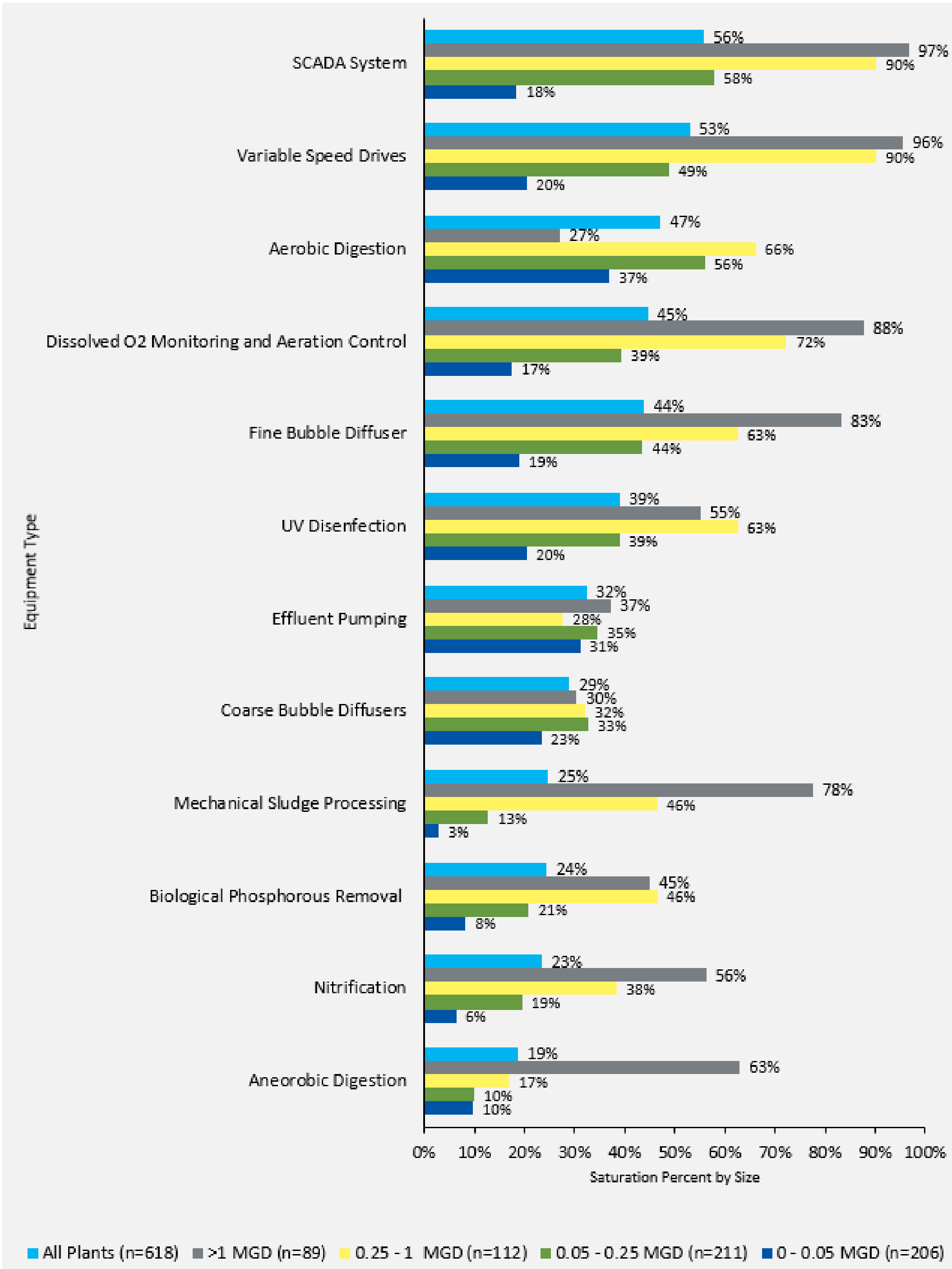
Respondents reported saturation below 30% for the following measures:

- Coarse bubble diffusers (n=179)
- Mechanical sludge processing (n=155)
- Biological phosphorous removal (n=148)
- Nitrification (n=142)
- Anaerobic digestion (n=117)

In general, plants with an average MGD capacity of 0.25 or greater had higher levels of equipment saturation than plants with an average MGD below 0.25. However, certain measures had comparable levels of saturation in all plants. For example, effluent pumping systems (or sump pumps) and coarse bubble diffusers had relatively equal levels of saturation regardless of plant size.

Figure J-1 shows the saturation of energy-efficient equipment across WWTPs by plant size.

Figure J-1. Saturation of WWTP Equipment and Practices in WWTPs



Source: 2020 CMAR Data. Question 7.2.1 "Indicate equipment and practices utilized at your treatment facility (Check all that apply)."

Pump and Lift System Equipment Saturation

Pump and lift stations contain a variety of components such as pumps, valves, and control systems to move wastewater from a low elevation to a higher elevation within a given wastewater collection system.[57] A wastewater collection system is responsible for moving sanitary wastewater from the point of discharge to a wastewater treatment plant.

At least 50% of plant collection systems used three types of the listed equipment. The most utilized equipment was the submersible pump (79% of all plants). After that, the most utilized equipment included flow metering and recording (53%) and SCADA systems (50%). The use of pneumatic pumping stations was low across all plants (4%). Pneumatic pumps have benefits for tank cleaning and are more effective for sludge pumping, while the submersible pump is more efficient for liquid pumping.[58] Low saturation of pneumatic pumps, in comparison to the high saturation of submersible pumps, suggests a higher versatility in usage for submersible pumps than for pneumatic pumps.

The use of equipment increased with capacity. Facilities with a capacity of >1 MGD had the highest representation of equipment with a saturation above 50% for submersible pumps (83%), flow metering and recording devices (62%), SCADA systems (88%), self-priming pumps (54%), and VSDs (66%). However, utilization and high saturation were comparable for all plant sizes for submersible pumps, flow metering, and recording equipment.

Extended shaft pumps with combined saturation across all plants (7%) were at least three times more likely to be used in plants with a capacity of >1 MGD (21%) than all other plants (5% across plants with an average MGD of 1 or lower).

Figure J-2 summarizes the saturation of equipment across WWTP collection systems by plant size**.**

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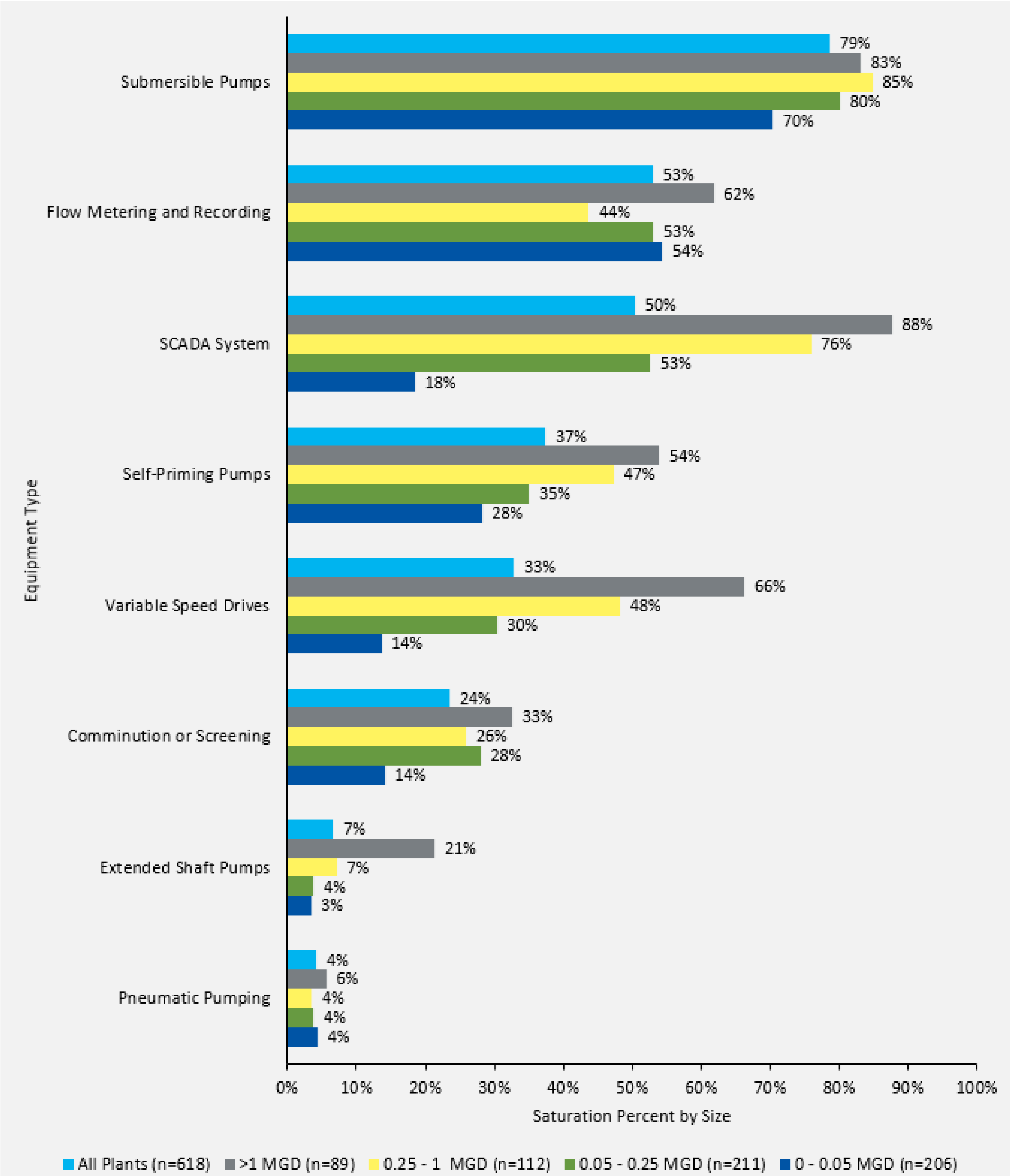
57 Water Environmental Federation. 2019. *Sanitary Sewer Systems: Lift Stations and Data Management Fact Sheet*. wsec-2019-fs-013---csc-mrrdc---lift-stations-and-data-management---final.pdf (wef.org)

58 Environmental Protection Agency. 2000. *Collection Systems Technology Fact Sheet Sewers, Lift Station.* Collection Systems Technology Fact Sheet: Sewers, Lift Station (epa.gov)

Figure J-2. Saturation of Collection System WWTP Equipment



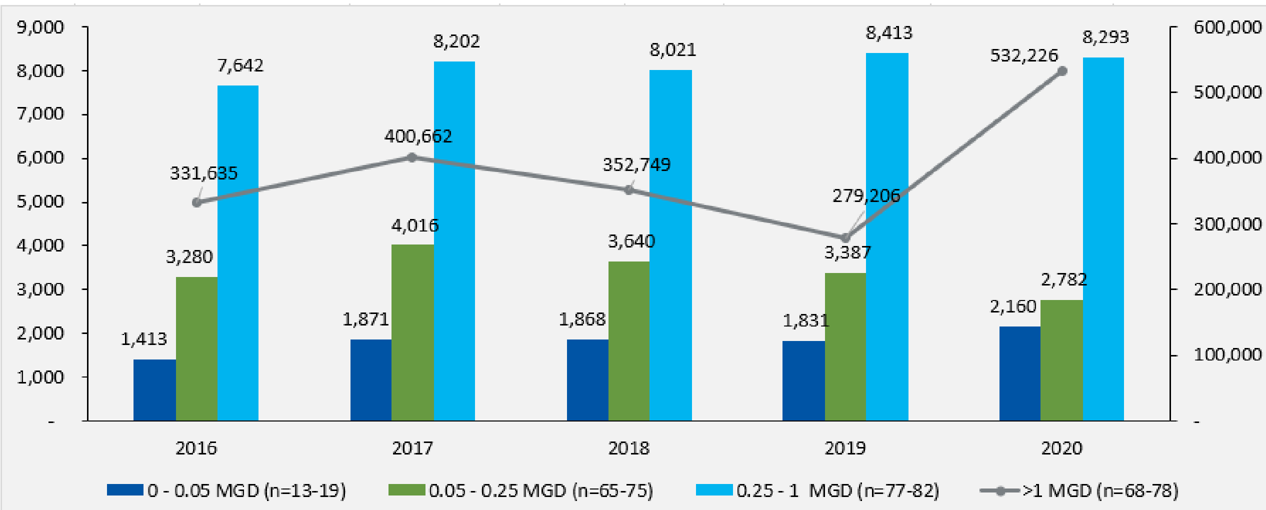
Source: 2020 CMAR Data. Question 6.2.1 "Indicate equipment and practices utilized at your pump/lift stations (Check all that apply)."

Treatment Plant Energy Usage

Figure J-3 shows the average annual natural gas consumption for WWTPs by plant size. Given the large difference in scale between natural gas usage in plants sized >1 MGD compared to plants below that size, the usage for plants sized >1 MGD is shown in a gray line, and usage for other plant sizes is shown in bars. Average annual natural gas usage increased from 2017 to 2020 for all plant sizes except those sized between 0.05 MGD and 0.25 MGD.

CMAR data showed that plants sized 0 MGD to 0.05 MGD deviated from the yearly trend and increased by 412% from 2018 to 2019. The evaluation team determined that this was likely due to a user input error for a single WWTP. After removing the outlier facility from the analysis, plants sized 0 MGD to 0.05 MGD show a consistent trend of gradual increase in therm consumption throughout the years.

Figure J-3. Average Annual Natural Gas Consumed (therms) by Year and Size

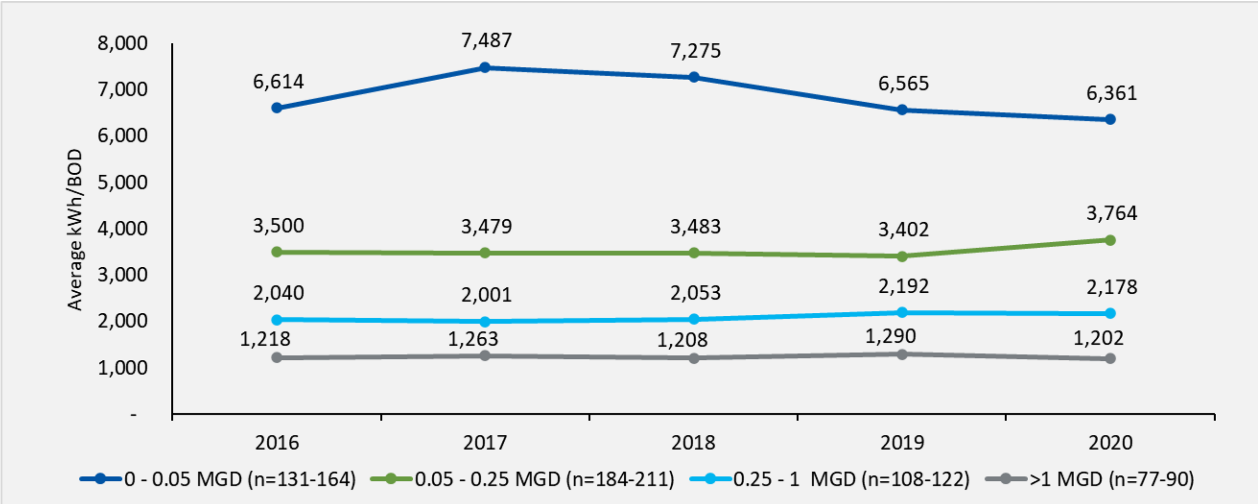


Source: CMAR Analysis Source: 2020 CMAR Data. Question 7.1.1
"Enter the monthly energy usage from the different energy sources:"

Water and wastewater utility managers index their facilities' electricity usage through a production or demand index, such as kWh per 1,000 lbs. of biological oxygen demand (BOD) or kWh per MGD. This index is called a Key Performance Index or Energy Performance Index.

As shown in Figure J-4**,** the average kWh per BOD did not vary greatly from 2016 to 2020 across plants of all sizes. Plants sized 0 MGD to 0.05 MGD had the highest average kWh per BOD usage, while plants sized >1 MGD had the lowest average kWh per BOD.

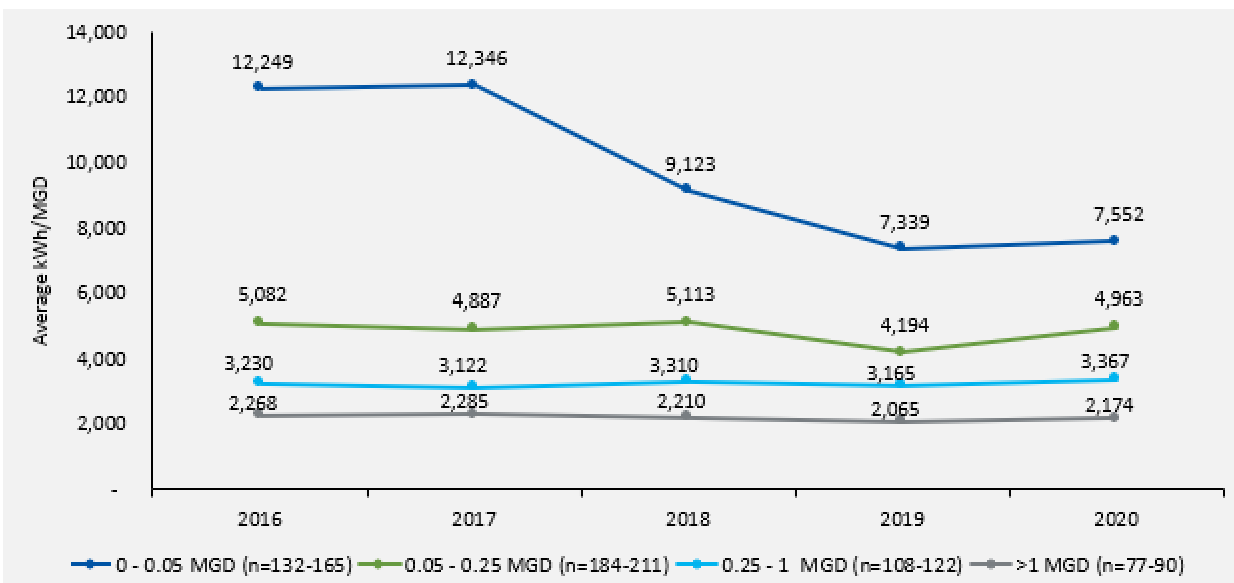
Figure J-4. Average Wastewater Treatment Plant kWh per BOD by Size and Year



Source: 2020 CMAR Data. Question 7.1.1 “Enter the monthly energy usage from the different energy sources:”

Figure J-5 shows the average reported kWh per MGD also remained consistent across plants of all sizes from 2016 to 2020, except for plants sized 0 MGD to 0.05 MGD, which decreased by 4,697 kWh per MGD (38%) between 2016 and 2020.

Figure J-5. Average Wastewater Treatment Plant kWh/MGD by Size and Year



Source: 2020 CMAR Data. Question 7.1.1 “Enter the monthly energy usage from the different energy sources:”

Energy Studies

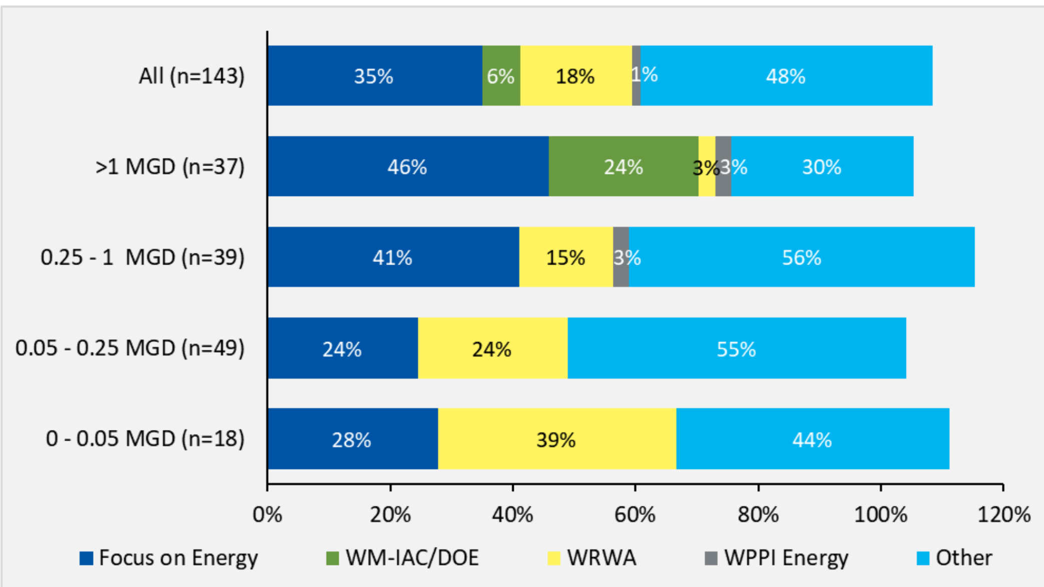
This section describes treatment plant energy assessments, the collection system energy assessments and how they relate to various WWTPs by facility size (MGD), and the various providers’ focus on different sized facilities for assessment. The primary study providers are Focus on Energy, The University of Wisconsin-Milwaukee Industrial Assessment Center/U.S. Department of Energy (WM-IAC/DOE), Wisconsin Rural Water Association (WRWA), and WPPI Energy.

Treatment Plant Energy Assessments

WWTPs sized >1 MGD and 0.25 MGD to 1 MGD were more likely to use Focus on Energy as their study provider (46% and 41%, respectively) than plants sized 0.05 MGD to 0.25 MGD and 0 MGD to 0.05 MGD (24% and 28%, respectively). Additionally, plants sized 0 MGD to 0.05 MGD and 0.05 MGD to 0.25 MGD were more likely to use WRWA as their study provider (39% and 24%, respectively). The WM-IAC/DOE performed only 6% of all collection system studies across all plants and had conducted assessments only on plants sized >1 MGD. After the Other category, which mostly encompasses private engineers, Focus on Energy was the main study provider for plants of all sizes (35%).

Figure J-6 shows the WWTP assessments by plant size and study provider.

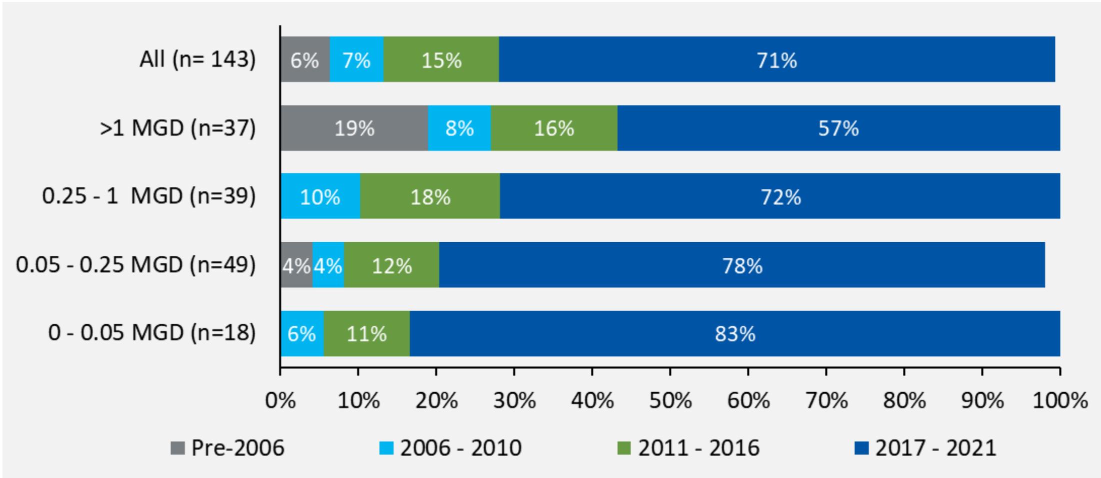
Figure J-6. 2020 Treatment Plant Energy Assessment by Size and Study Provider



Source: CMAR Data. Question. 9.1 “Has an energy study been performed for your treatment facility?” Multiple responses were allowed, which resulted in a sum greater than 100% for every plant size category.

As shown in Figure J-7, 71% of WWTP energy assessments across plants of all sizes occurred between 2017 to 2021. Eighty-three percent of plants sized 0 MGD to 0.05 MGD and 78% of plants sized 0.05 MGD to 0.25 MGD received an assessment after 2016. Only 57% of plants >1 MGD received an assessment after 2016. Nineteen percent of plants >1 MGD received a plant assessment prior to 2006, compared to 6% of all plants.

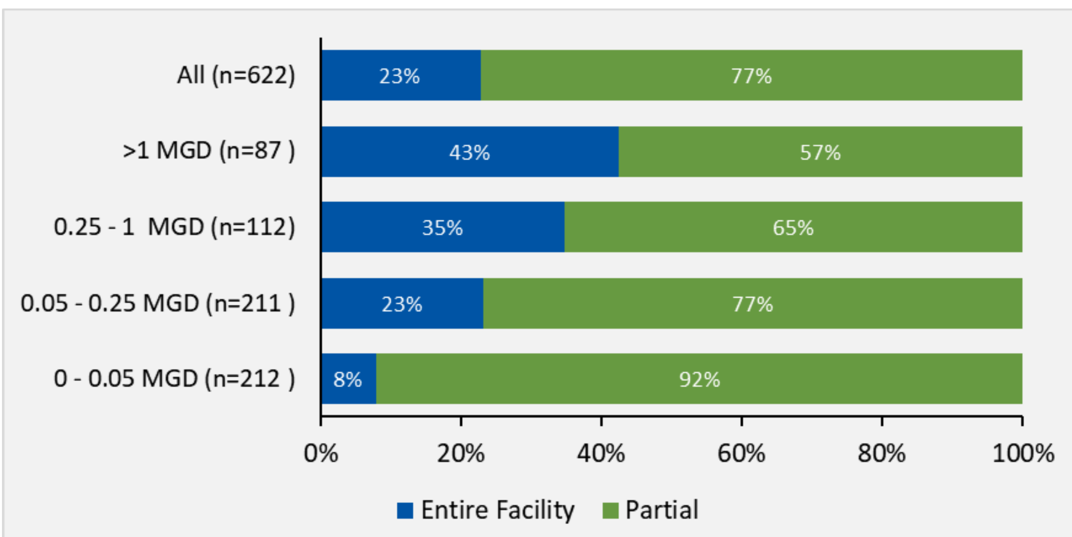
Figure J-7. 2020 Treatment Plant Energy Assessment by Size and Year



Source: CMAR Data. Question. 9.1 "Has an Energy Study been performed for your treatment facility?"

Figure J-8 breaks out entire-facility assessments versus partial-plant assessments. Partial-plant assessments were three times more common than entire-facility assessments across plants of all sizes, and over 11 times more common in the smallest plants sized 0 MGD to 0.05 MGD. The prevalence of entire-facility assessments increased as plant size increased. Forty-three percent of plants sized >1 MGD completed entire-facility assessments compared to only 8% of plants sized 0 MGD to 0.05 MGD.

Figure J-8. 2020 Treatment Plant Energy Assessment by Size and Assessment Type

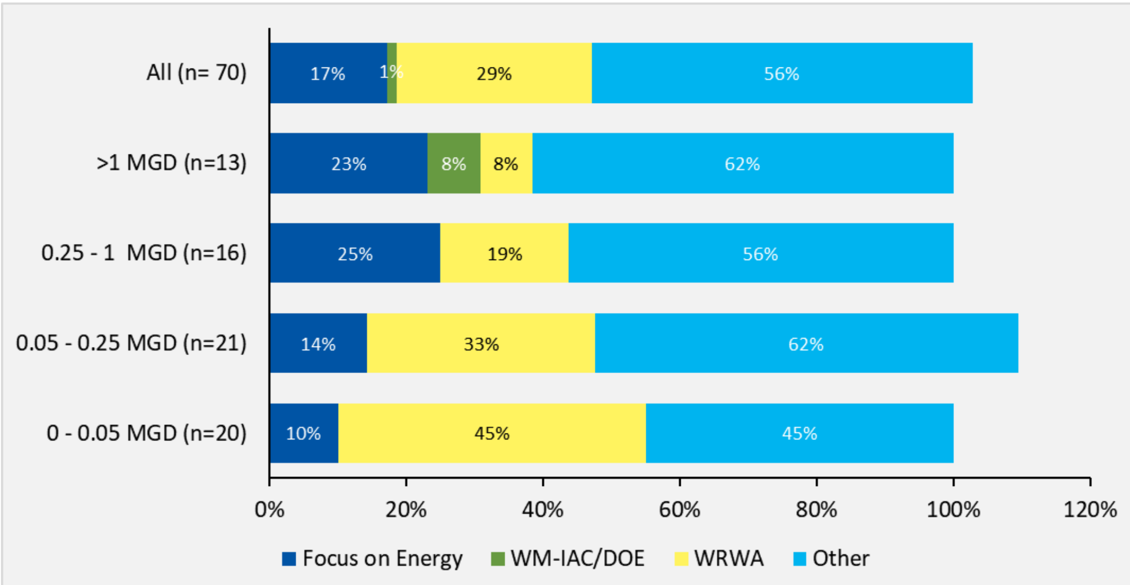


Source: 2020 CMAR Data. Question 9.1 "Has an energy study been performed for your treatment facility?"

Collection System Energy Assessments

As shown in Figure J-9, 56% of WWTPs that received a collection system energy assessment used a study provider other than Focus on Energy, WM-IAC/DOE, or WRWA between 2000 and 2020. After the Other category, WRWA provided most of the studies for plants of all sizes (29%). Larger plants (sized >1 MGD and 0.25 MGD to 1 MGD) were more likely to use Focus on Energy as their study provider (23% and 25%, respectively) than the smaller plants. Smaller plants (0 to 0.05 MGD) were more likely to use WRWA as their study provider. The WM-IAC/DOE performed only 1% of all collection system studies and conducted assessments only on plants sized >1 MGD.

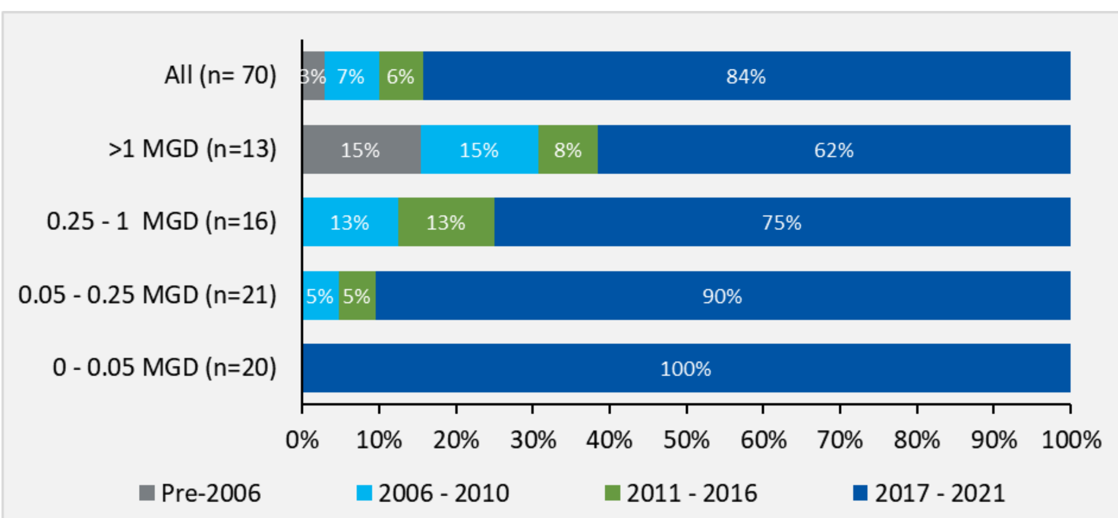
Figure J-9. Collection System Energy Assessment by Size and Study Provider (Between 2000 and 2020)



Source: CMAR Data. Question. 9.1 “Has an energy study been performed for your treatment facility?”
Question sums over 100% indicate plants having multiple studies completed by different providers.

As shown in Figure J-10, most collection system energy assessments across plants of all sizes occurred between 2017 and 2021. The time between each plant’s last assessment increased with plant size. All plants sized 0 MGD to 0.05 MGD received an assessment between 2017 and 2021, and only 62% of plants sized >1 MGD received an assessment after 2016.

Figure J-10. 2020 Collection System Energy Assessment by Size and Year



Source: 2020 CMAR Data Question. 6.3 “Has an energy study been performed for your pump/lift stations?”

Wastewater Treatment Plant Survey Results

The evaluation team conducted a multimode survey with 84 publicly and privately owned WWTP decision-makers who had submitted their CMAR report to the Wisconsin DNR in 2020. Respondents had to be responsible for making equipment decisions for a WWTP and collection system in Wisconsin to participate in the survey.

The objectives of the survey were to assess the following by size and ownership type:

- The level of concern about energy costs by plant ownership type and size
- The saturation of efficient measures and likelihood to install efficiency measures as well as barriers to installing energy-efficient measures
- How Focus on Energy can help overcome barriers to install efficient measures
- Awareness of Focus on Energy offerings and recent participation levels
- Interest in trainings and potential Focus on Energy offerings
- Decision-making around plant upgrades

From January to February 2023, the team contacted a sample of 620 WWTP decision-makers across Wisconsin. Of these, 84 completed the survey. As shown in Table J-3, the team met its quota of survey completes for all plant-size segments. The team created the sample frame from the contact information provided in the CMAR reports. Based on this population size, the 84 surveys completed achieved ±9.9% precision at the 95% confidence level. For the four plant size segments, the smaller sample sizes achieved ±15% precision or better at the 85% confidence level.

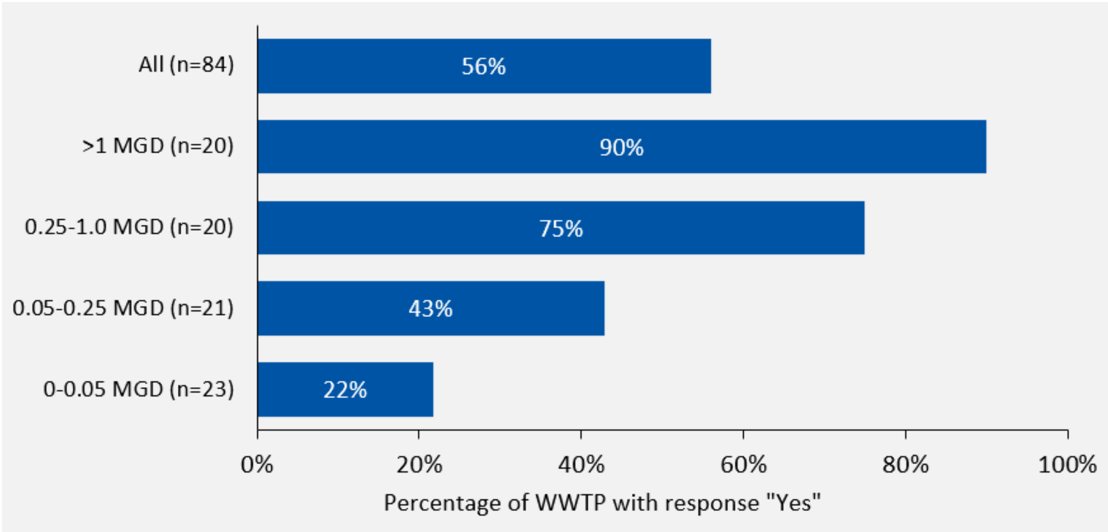
Table J-3. CY 2022 Wastewater Treatment Plant Survey Sample Information

Segment	Sample Frame	Target Completes	Completed Surveys	Precision and Confidence Level
0 - 0.05 MGD	211	21	23	±14.2% at 85%
0.05 - 0.25 MGD	210	21	21	±14.9% at 85%
0.25 - 1 MGD	112	20	20	±14.6% at 85%
>1 MGD	87	19	20	±14.1% at 85%
Total	**620**	**81**	**84**	**±9.9% at 95%**

Awareness and Interest in Focus Offerings

Of the 84 WWTP decision-makers surveyed in CY 2023, 56% were aware of Focus on Energy's incentive offerings before taking the survey (Figure J-11). Respondents varied in their familiarity with Focus on Energy's incentive offers in accordance with their size. Of the larger plants, 75% of the respondents in the 0.25 MGD to 1.0 MGD segment and 90% of the >1 MGD segment had heard of the offerings. Respondents from the smaller plants showed less awareness of the incentive offerings, with 22% of the respondents in the 0 MGD to 0.05 MGD segment and 43% of the 0.05 MGD to 0.25 MGD segment who were aware.

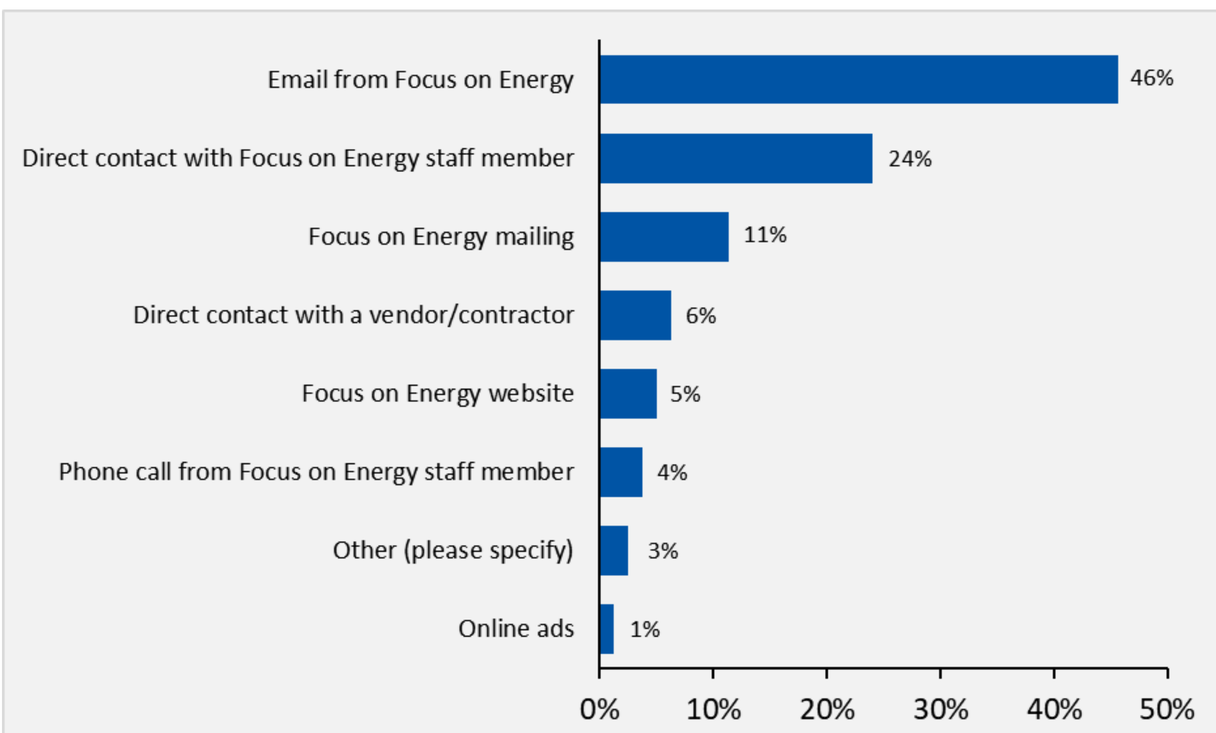
Figure J-11. Awareness of Focus on Energy Offerings



Source: 2022 Wastewater Treatment Plant Survey Question G2. "Before today, had you heard anything about Focus on Energy's energy-efficiency incentive offerings that help wastewater treatment plants reduce their energy consumption and save money on their energy bills?"

In CY 2023, respondents reported that emails from Focus on Energy (46%) and direct contact with Focus on Energy staff (24%) were their preferred ways of learning about the incentives (Figure J-12).

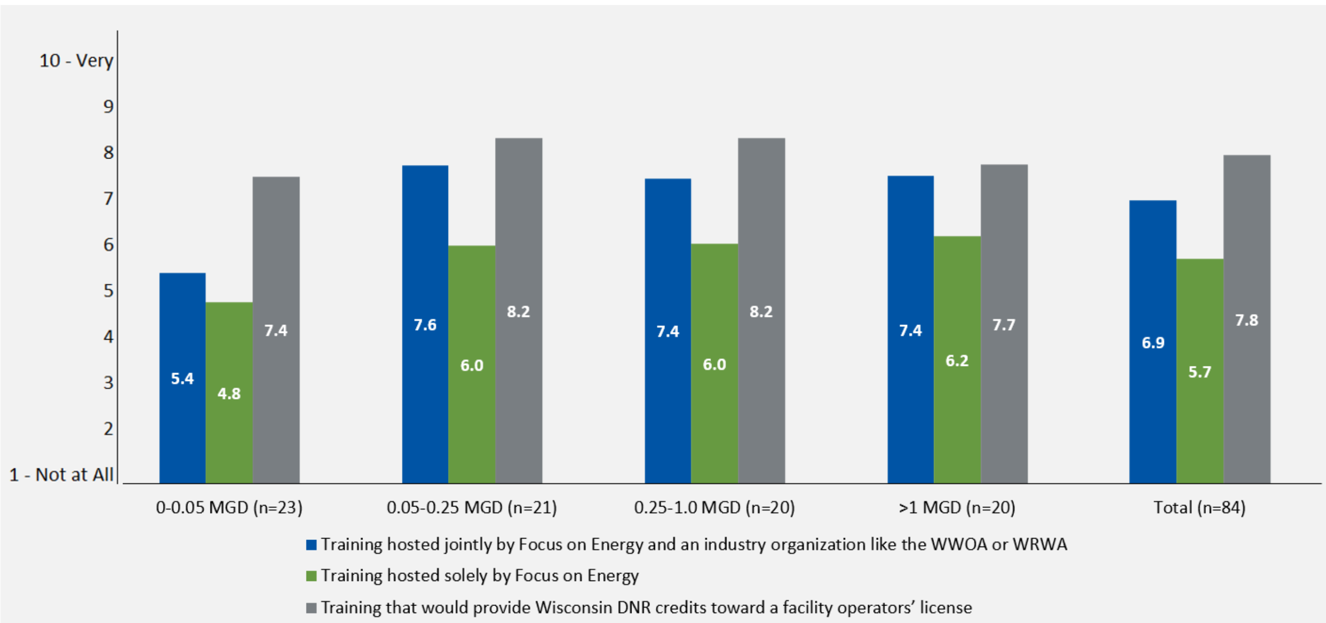
Figure J-12. Preferred Method of Communication for Information About Incentives



Source: 2022 WWTP Survey Question G7. "What is the best way for Focus on Energy to let you know about their incentives for energy-efficiency improvements?" (n=79).

The survey asked respondents to rate their interest in receiving various training on energy efficiency, energy generation, and renewable energy opportunities on a scale of 1 (*not at all interested*) to 10 (*very interested*). Training that would provide continuing education credits, which the DNR requires to maintain a Wastewater Operator Certification in Wisconsin,[59] generated the most interest (average rating 7.8), followed by training held jointly with industrial organizations (6.9). Training hosted solely by Focus on Energy generated the least interest (5.7). This pattern was consistent across plants of different sizes (Figure J-13). Respondents from small-sized plants (0 MGD to 0.05 MGD) showed less interest in all types of training compared to those from larger plants (0.05 MGD or greater).

Figure J-13. Interest Ratings for Focus on Energy Training



Source: 2022 Wastewater Treatment Plant Survey Question G8. "On a scale of 1 to 10 where 1 is *not at all interested* and 10 is *very interested*, how interested are you in the following types of training about wastewater treatment plant energy efficiency, energy generation, or renewable energy opportunities?" (n=84).

Barriers to Participating in Focus on Energy

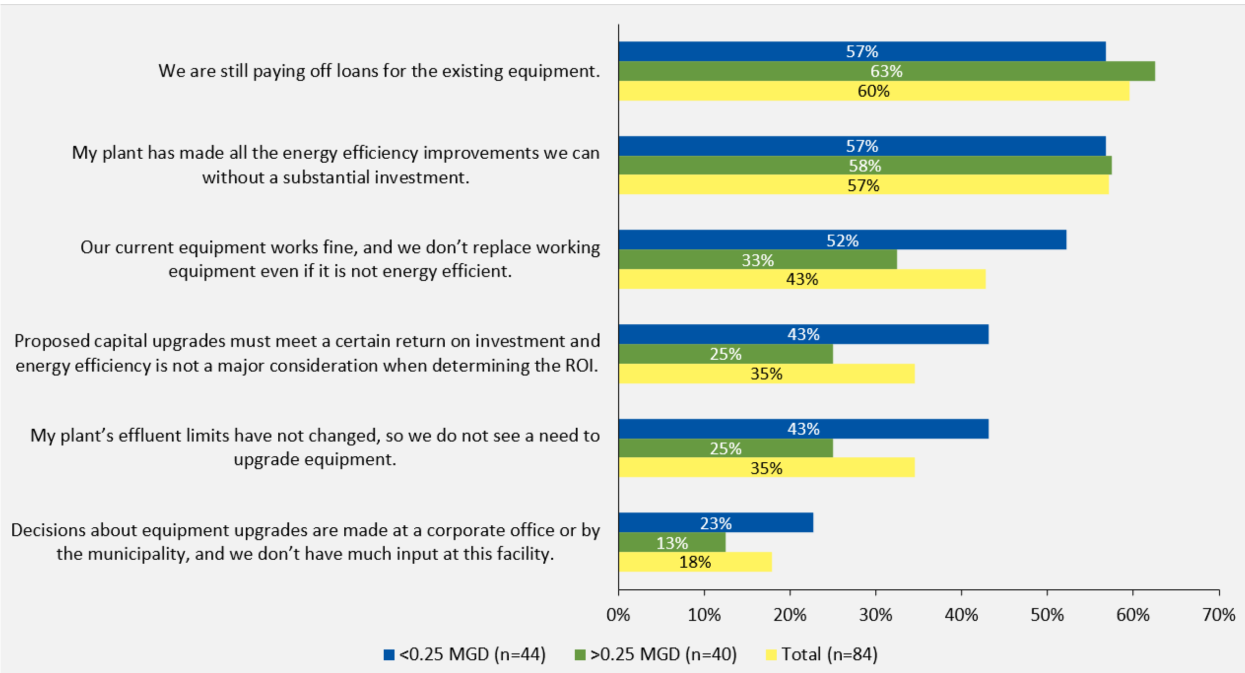
The study asked respondents about the perceived barriers to participation in Focus on Energy programs. Out of the 84 respondents, cost was the most common challenge to implementing energy efficiency projects and upgrades (77%, n=65), followed by the organization's internal decision-making or budgeting process (12%, n=10). Larger plants (>1 MGD, N=20) were the most likely to mention internal processes as a barrier (20%, n=5) and smaller plants (0 MGD to 0.5 MGD, N=23) were the least likely (4%, n=1). No other barriers were cited by more than two respondents.

The survey asked respondents to rate their agreement with several scenarios that organizations experience when considering energy-efficient improvements, using a 4-point scale where a response of

59 Wisconsin Department of Natural Resources. "Wastewater Operator Certification." https://dnr.wisconsin.gov/topic/opcert/wastewater.html

1 is *strongly disagree* and a response of 4 is *strongly agree* (Figure J-14). Most respondents agreed that the following two scenarios applied to their organizations: "We are still paying off loans for existing equipment" (60%) and "My plant has made all the energy efficiency improvements we can without a substantial investment" (59%). Respondents agreed with these scenarios at similar rates across plant sizes. For the four remaining scenarios, respondents from plants <0.25 MGD (0 MGD to 0.05 MGD and 0.05 MGD to 0.25 MGD) were more likely to agree than respondents from plants >0.25 MGD (0.25 MGD to 1 MGD and >1 MGD). Only 18% respondents agreed that the scenario "Decisions about equipment upgrades are made at a corporate office or by the municipality" was applicable to their situation.

Figure J-14. Agreement with Scenarios When Considering Energy-Efficient Improvements



Source: 2022 Wastewater Treatment Plant Survey Question F3. "For the following scenarios that companies experience when purchasing new equipment or considering energy-efficient improvements, please indicate whether you agree with these statements. If the statement doesn't apply to you, please indicate it is not applicable." The percentages shown are for combined *strongly agree* and *somewhat agree* responses.

Decision-Making and Energy Efficiency Attitudes

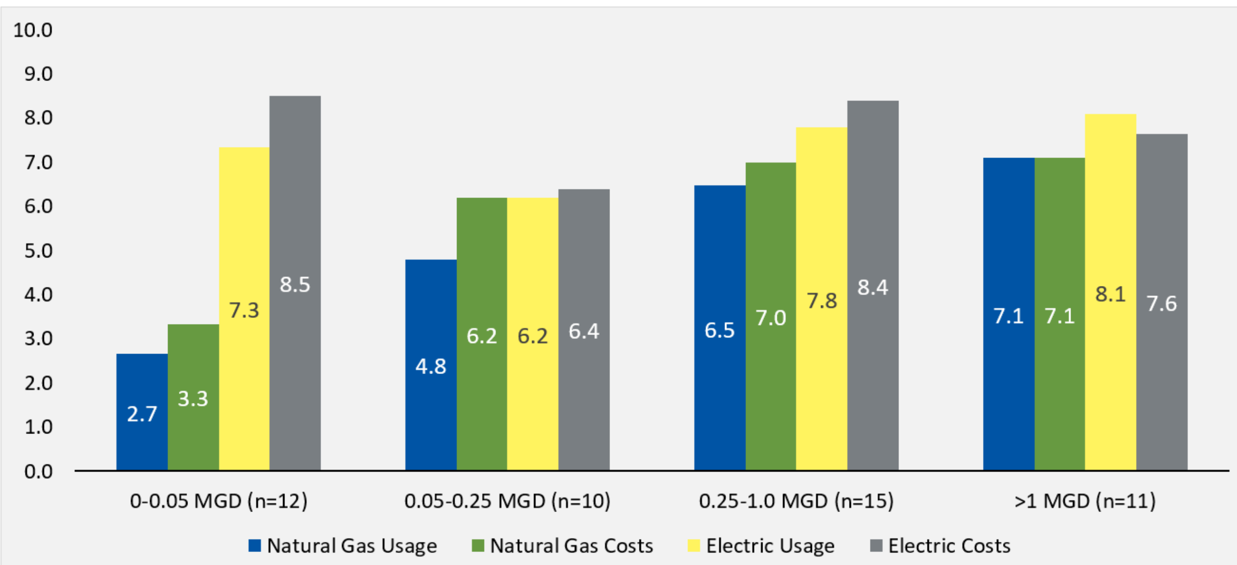
Eighty-seven percent (n=73) of respondents reported that their facilities were municipally owned and operated, while 5% (n=4) were privately owned and operated, and 8% (n=7) were municipally owned but privately operated.

Only 7% of respondents (6 out of 84) said that nobody at their plant receives monthly energy bills, and five of those six plants were smaller plants (<0.25 MGD). Among the plants that had someone designated to receive utility bills, 33% (n=52) monitored monthly bills *very closely* and 60% monitored them *somewhat closely*. Larger plants (>1 MGD) were more likely than smaller plants to monitor bills *very closely* (54%, n=13). Only one respondent (1%) reported monitoring monthly bills *not at all closely*, and this respondent also represented a large plant (>1 MGD).

The study asked respondents who were familiar with the energy bills at their facilities about their energy use and cost concerns on a scale of 1 to 10, where 1 is *not at all concerned* and 10 is *very concerned* (Figure J-15). Across all plant sizes, respondents expressed concerns about electric costs and usage greater than natural gas costs and usage. Facilities that produce greater than 0.05 MGD (n=36) show higher concerns with natural gas costs and usage, while facilities that produce less than 0.05 MGD (n=12) express lower concerns for natural gas costs.

Respondents from plants >1 MGD rated their concern with natural gas costs and usage (7.1 for both), the highest compared to other sized facilities. Respondents from the smallest plants (0 MGD to 0.05 MGD) rated their electric costs concern the highest of the facilities (8.5); however, small facility respondents were not particularly concerned with natural gas usage (2.7) and costs (3.3). All other plant sizes rated their concerns above a 4. Overall, electric usage and costs are a higher concern for plant managers than for natural gas.

Figure J-15. Electricity and Natural Gas Use and Cost Concerns

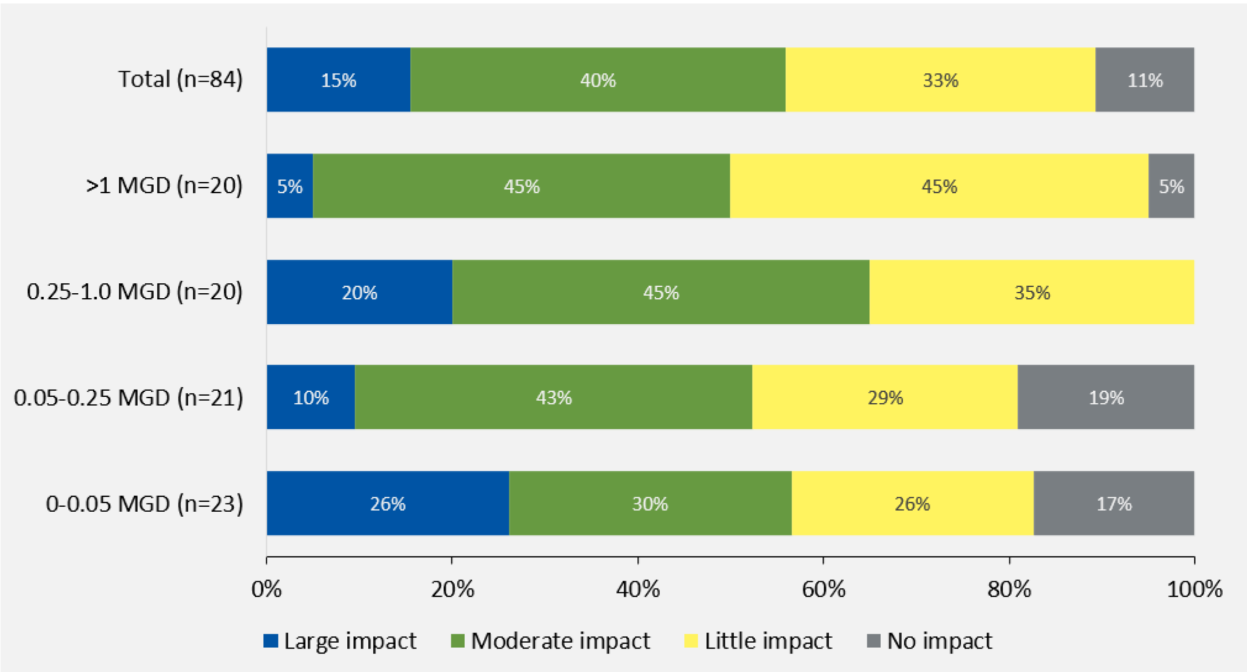


Source: 2022 Wastewater Treatment Plant Survey Question D6_1-D6_4. "On a scale of 1 to 10 where 1 is not at all concerned and 10 is very concerned, how concerned are you about the following at your wastewater treatment plant? Electricity costs, Electricity use, NG use, NG cost."

The survey asked respondents whether liquid treatment or solids management had more influence on energy costs at their facilities. Among 42 respondents who monitored their energy bills at least *somewhat closely*, 86% said liquid treatment had more influence on energy costs and 14% said solids management. Respondents from larger plants >0.25 MGD were more likely to say solids management was more influential than liquid treatment (22%, n=23) than respondents at smaller plants <0.25 MGD (5%, n=19).

The survey asked respondents about the impact of effluent discharge permit changes for WWTPs that recalculates the formula for effluent discharge limitations (Figure J-16).[60] Overall, 89% (n=75) of respondents said the permit changes were having an impact at their plant. Fifteen percent (n=13) indicated permit changes were having a *large impact*, while 40% (n=34) said a *moderate impact*. Only 11% (n=9) reported having *no impact* from the permit changes. Respondents from the smallest plants (0 MGD to 0.05 MGD) were more likely to report a *large impact* (26%, n=6) compared with the largest plants (>1 MGD). Only one plant (5%) sized >1 MGD reported a *large impact.* However, respondents from the smallest plants (0 MGD to 0.05 MGD) were also the most likely to describe permit changes as having a *no impact* (17%, n=4). These responses indicate that plant size is not a factor in impact from changes in effluent discharge rules.

Figure J-16. Effluent Discharge Permit Change Impact



Source: 2022 Wastewater Treatment Plant Survey Question D8. “To what extent do you think your plant’s energy use has been impacted by recent effluent discharge permit changes?”

The survey asked respondents if their plants have energy efficiency policies that are taken into consideration when purchasing new equipment or making improvements. None of the respondents from plants sized <0.05 MGD reported having such policies, though 26% (n=23) did not know if their plant had such a policy. For plants that process 0.05 MGD or more, 21% of respondents reported having

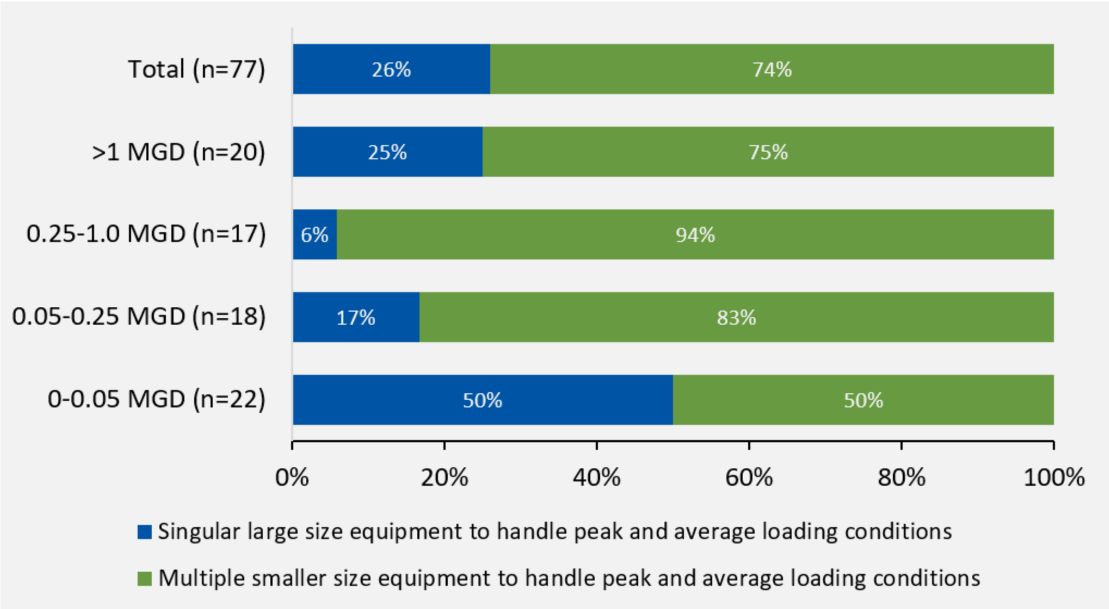
60 Wisconsin Department of Natural Resources. August 1, 2021. *WPDES Permit*. https://dnr.wisconsin.gov/sites/default/files/topic/Wastewater/B057681-05-0_Permit.pdf

Wisconsin Department of Natural Resources. 2021. *Chapter NR 106 Procedures for Calculating Water Quality Based Effluent Limitations for Point Source Discharges to Surface Waters.* https://docs.legis.wisconsin.gov/code/register/2021/782B/insert/nr106 energy efficiency policies, and only 5% did not know if their plant had such a policy. Most of the 12 respondents who could describe the energy efficiency policies at their plant described their policy as *purchase energy efficient equipment if it meets return on investment criteria* (50%) or *purchase energy efficiency equipment if it fulfills goals or requirements in a sustainability plan* (42%). Only one reported that the policy was to *always purchases energy efficient equipment as a rule* (8%; response from a plant sized 0.25 MGD to 1.0 MGD).

The survey asked respondents, as follow-up questions, if they were more likely to implement one large piece of equipment or multiple small-sized pieces of equipment. Seventy-four percent (n=77) of respondents were more likely to implement multiple pieces of small-size equipment over a single piece of large-size equipment (Figure J-17). However, respondents from plants sized 0 MGD to 0.05 MGD were split evenly between equipment options (50% each, n=22).

Respondents reported three primary factors for implementing single large-sized equipment (n=20): 30% said ease of maintenance, 20% did not know, and 15% said cost. However, respondents (n=55) were more likely to implement multiple small-sized equipment for system backup (35%), flexibility (18%), and costs (15%).

Figure J-17. Potential Implementation over the Next 20 Years by Plant Size



Source: 2022 Wastewater Treatment Plant Survey Question H7. "When designing your plant upgrades for the next 20 years, which design scenario are you more likely to implement?"

Energy-Efficient Equipment Saturation

The evaluation team asked respondents to answer questions about specific types of energy efficiency equipment: what was already installed at their plants, their potential interest in installing those types of equipment, and their likelihood of actually installing the equipment.

Current Utilization of Energy Efficient Equipment

Nearly 70% of respondents from plants sized 0 MGD to 0.05 MGD (n=16) were not aware if any of the energy-efficient equipment listed in the survey was included at their plants, which meant only 30% (n=7) of plant managers were aware of efficient equipment in their plants. Conversely, 85% of respondents from plants sized 0.05 MGD to >1 MGD (n=52) were aware of the current utilization of energy-efficient equipment in their plants. Overall, 59 respondents provided the types of installed equipment.

Depending on plant operations and design, aeration can take place in multiple processes such as aerobic digestion, aerated grit removal, dissolved air flotation (DAF), and ammonia removal.

The survey asked about equipment related to bubble diffusers and aeration blowers with VFD or VSD technologies. Bubble diffusers are discs installed in equipment pipes that force air bubbles through to allow the aeration of water and, in the case of aerobic digestion, increase the flow of oxygen for microorganisms to break down the pollutants in sewage. Aeration blowers are critical for containing activated sludge content in a suspended environment. The application of VSDs or VFDs in the system would increase the electric energy efficiency of the aeration blower systems.

Table J-4 shows responses by plant type and indicates which plants already have the specific energy-efficient equipment installed. Overall, the use of fine bubble diffusers in aerations tanks was most prevalent (56%). Aeration blowers with a VSD and automatic control system were next (41%) and in place at 24 plants. This was followed by fine bubble diffusers in aerobic digesters and aerator blowers with VFD or VSD without automatic control systems (36%), each used at 21 plants.

Table J-4. Current Facility Equipment by Plant Type

Equipment	0-0.05 MGD (n=7)	0.05-0.25 MGD (n=14)	0.25-1.0 MGD (n=20)	>1 MGD (n=18)	Total (n=59)
Fine bubble diffusers in the aeration tanks (Instead of coarse bubble diffusers or mechanical aeration)	3	7	10	13	**33**
Aeration blowers with variable speed drives and an automatic control system to monitor dissolved oxygen and automatically adjust the speed of the blower	0	3	9	12	**24**
Fine bubble diffusers in aerobic digesters	4	7	8	2	**21**
Aeration blowers with variable frequency drives or variable speed drives that are sized for energy efficient	0	5	9	7	**21**
Cascade-aeration system for post-aeration	1	1	3	7	**12**
Highly efficient turbo aeration blower technology	0	2	3	2	**7**
Equipment to beneficially utilize biogas	0	0	1	5	**6**
Fine bubble diffusers for post-aeration	0	0	3	2	**5**
Fine bubble diffusers for channel aeration	0	1	0	1	**2**

Source: 2022 Wastewater Treatment Plant Survey Question. E2 "Which of the following equipment does your wastewater treatment plant currently have?"

Interest in installing Energy-Efficient Equipment

The survey asked respondents to rate their interest in potentially installing equipment on a scale of 1 to 10, where 1 is *not at all interested* and 10 is *very interested*.

The figures in this section use abbreviated descriptions of the equipment options to allow the results to be displayed in a legible way. Table J-5 lists the abbreviated text and the full text as it appeared in the survey.

Table J-5. Abbreviated Text for Figures 18, 19, and 20

Abbreviated Text	Full Description Text
Aeration variable speed drives and automatic control system	Aeration blowers with variable speed drives and an automatic control system to monitor dissolved oxygen and automatically adjust the speed of the blower
Aeration variable frequency drives or variable speed drives	Aeration blowers with variable frequency drives or variable speed drives that are sized for energy efficient operation
Fine bubble diffusers in the aeration tanks	Fine bubble diffusers in the aeration tanks (Instead of coarse bubble diffusers or mechanical aeration)

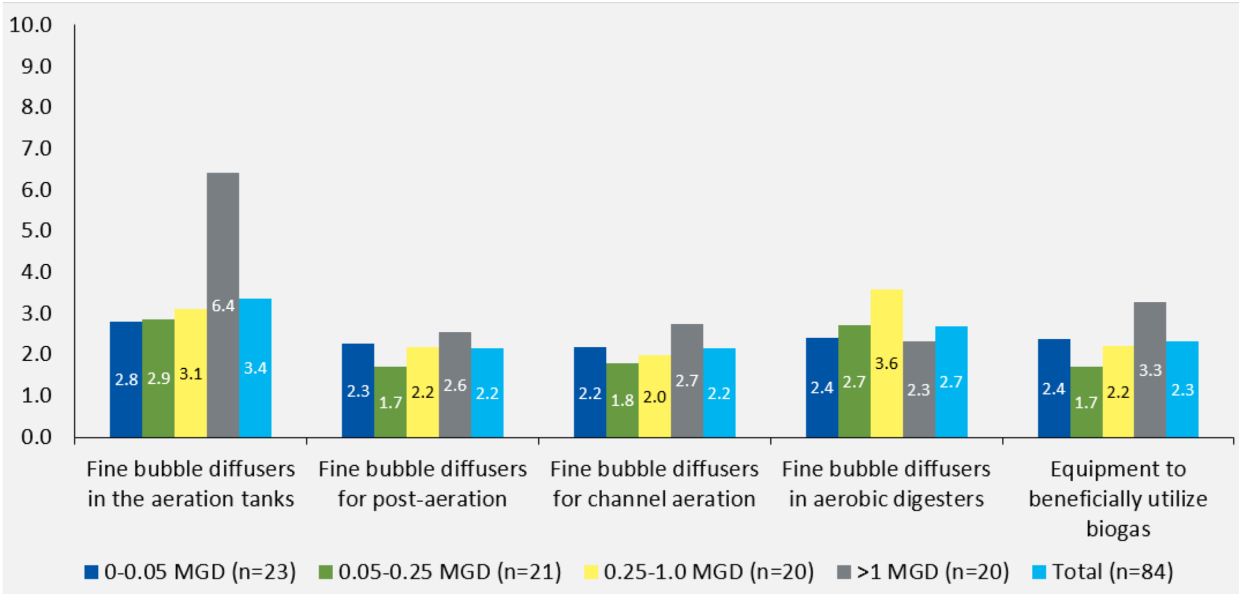
Overall, none of the equipment listed in the survey achieved an average rating above 5 across all plant respondents, indicating low to medium interest of installation for all measures.

Figure J-18 shows respondents' general interest in equipment related to fine bubble diffusers and biogas. Overall, the only type of equipment respondents rated their level of interest above a 3, on average, was the fine bubble diffuser in aeration tank. Compared with coarse bubble diffusers, fine bubble diffusers provide a greater oxygen transfer rate to the water in aeration tanks, which allows for more efficient aerobic treatment. This also allows for the blowers connected to these fine bubble diffusers to be run at much lower loads, thereby reducing energy consumption for the same amount of aeration.[61] Most of this interest came from respondents at plants sized >1 MGD. Respondents rated their interest in other fine bubble diffuser measures between an average of 2.2 (for post-aeration and for channel aeration) and 2.7 (for use in aerobic digesters).

Respondents also rated equipment to beneficially utilize biogas on the lower end. This ranged from an average rating of 1.7 from respondents at plants sized 0.05 MGD to 0.25 MGD to 3.3 from respondents at plants sized >1 MGD. On average, respondents rated their interest in biogas equipment a 2.3.

61 U.S. Department of Energy. December 1, 2021. *Utilize Fine-Bubble Diffusers in Aeration Tanks*. https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Tipsheet%201%20-%20Fine%20Bubble%20-%20Final.pdf

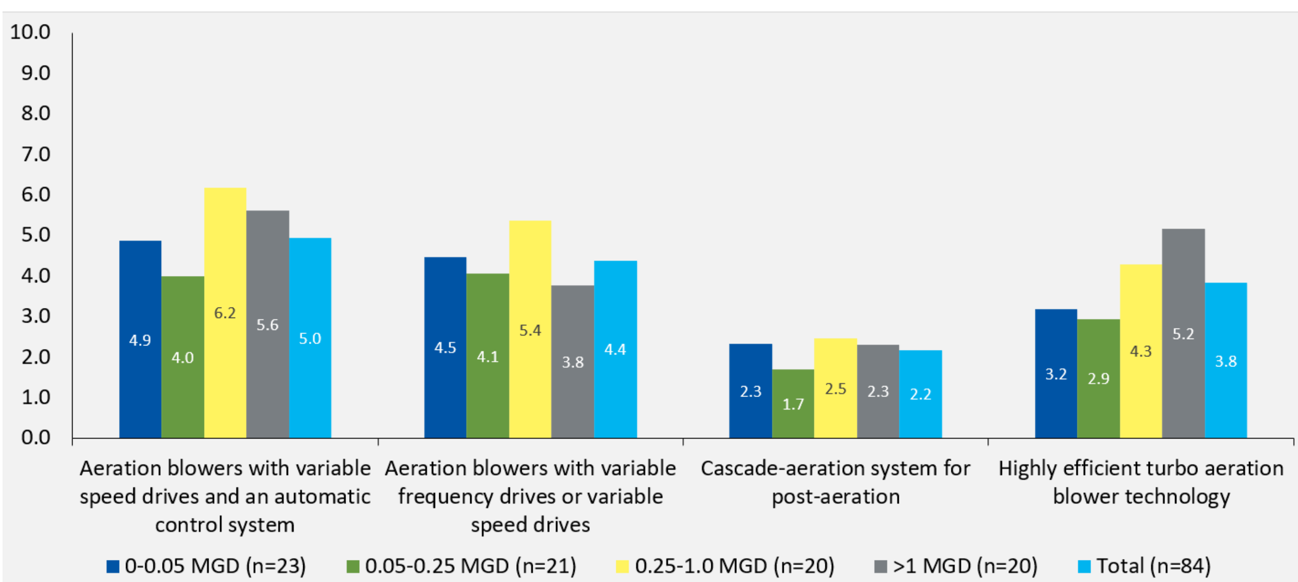
Figure J-18. General Interest in Installing Fine Bubble Diffusers and Biogas Efficient Technologies



Source: 2022 Wastewater Treatment Plant Survey Question. E3 "On scale of 1 to 10, where 1 is not at all interested and 10 is very interested, how interested are you installing the following technologies?"

Figure J-19 show respondents' general interest in aeration blower technologies. Respondents rated their interest in aeration blowers with VSDs and automatic control system the highest, with an average rating of 5.0 across all plants. This was followed by aeration blowers with VFDs and VSDs, which had an average rating of 4.4. Overall, respondents were more interested in aeration blowers than bubble diffusers or biogas equipment technology.

Figure J-19. General Interest in Installing Aeration Blower Technologies



Source: 2022 Wastewater Treatment Plant Survey Question. E3 "On scale of 1 to 10, where 1 is not at all interested and 10 is very interested, how interested are you installing the following technologies?"

Likelihood to Install Energy-Efficient Equipment

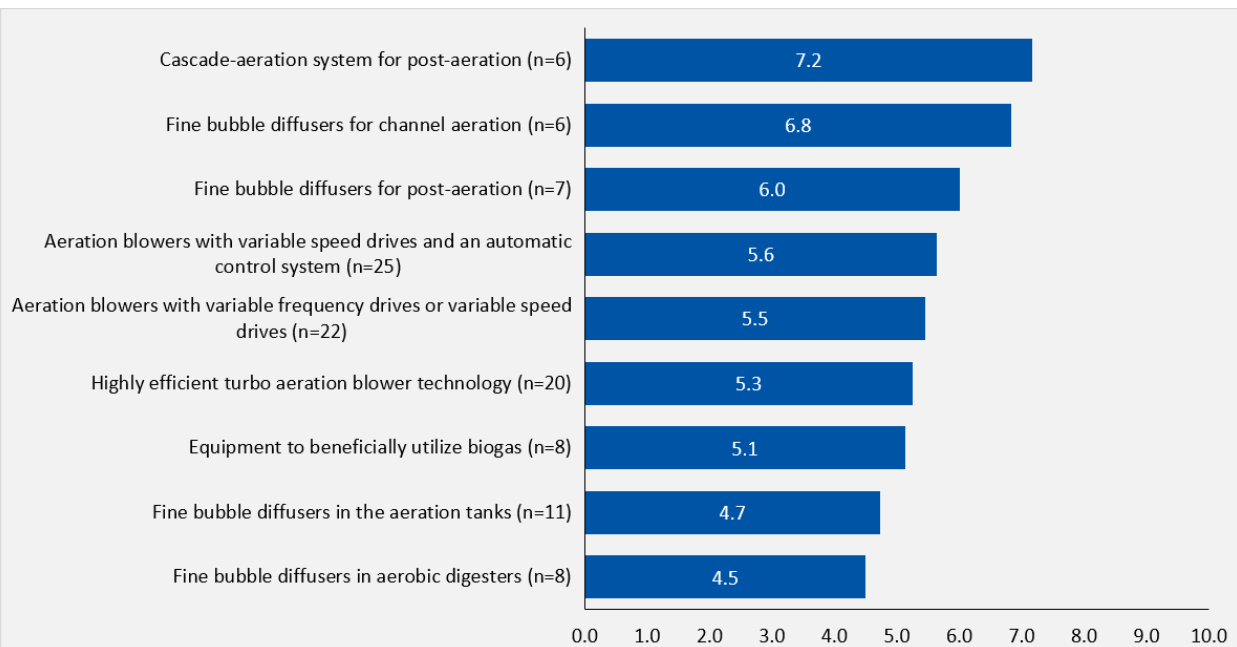
The survey followed up with respondents who rated their interest with a specific technology higher than 5 to rate their likelihood to install the equipment within the next five years, where 1 is *not at all likely* and 10 is *very likely*.

As shown in Figure J-20, while respondents gave an average rating of 2.2 for their overall interest in the cascade-aeration system, the respondents who were interested in the technology were likely to install it (7.2, n=6). Respondents were next mostly likely to install fine bubble diffusers for channel aeration and post-aeration, with average ratings of 6.8 and 6.0, respectively.

Aeration blowers with VSDs and an automatic control system had the highest number of responses, with 25 plant owners or facility managers indicating interest in installation of that equipment in their plant within the next five years. However, the average rating for likelihood to install was only 5.6. The aeration blowers with VFDs or VSDs without the automatic system had a similar average rating for likelihood to install (5.5, n=22). Twenty respondents showed high interest in adopting high-efficiency turbo aeration blower technology, with an average rating of 5.3 for the likelihood of installation.

Equipment that received lower ratings for likelihood to adopt were fine bubble diffusers in aeration tanks (n=11) and fine bubbler diffusers in aerobic digestors (n=8), which had average ratings of 4.7 and 4.5, respectively.

Figure J-20. Likelihood to Install Equipment in Next Five Years by Plant Size



Source: 2022 Wastewater Treatment Plant Survey Question. E4 "If E3>5, On scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely are you to install the following equipment in the next five years?"

Overall, aeration blower technology had the highest amount of interest, both in terms of average level of interest ratings and number of plant owners and facility managers who rated their interest above a 6.

Interest and likelihood to install aeration systems did not differentiate between plant sizes, which indicates that there is a wide market for those types of systems in the WWTP industry.

Fine bubble diffusers had lower interest on average compared with aeration blower technologies. The few respondents who were interested in pairing that technology with post-aeration or for channel aeration had the highest average ratings for likelihood of installation within the next five years.

Outcomes and Recommendations

The evaluation team reviewed information from CMAR and results of the survey administered by Cadmus to inform the following outcomes for the WWTP market assessment. The team offers recommendations to improve energy efficient equipment, offerings, and services to WWTPs in Wisconsin.

Outcome 1: While awareness of Focus on Energy's WWTP offerings correlated with facility output size, electric energy usage was a concern across facilities regardless of size. Ninety percent of facilities with an output size >1 MGD were aware of Focus on Energy offerings, compared to only 22% of facilities with an output size between 0 MGD to 0.05 MGD. Survey respondents rated their concern of electric usage at 7.4 and concern for electric costs at 7.8 (compared to 5.3 and 5.9 to gas usage and concerns, respectively). Electric incentives would benefit plant facilities of all sizes, while gas incentives would generally benefit larger facilities.

Outcome 2: Most facilities prefer to install large-size equipment to handle peak and average load conditions. Seventy-four percent of respondents (n=57) said they would prefer single large equipment replacements over installing multiple smaller-sized equipment. Facilities with an output size of 0.05 MGD or greater (71% of respondents) preferred large-size equipment replacements. However, facilities with an output size of 0 MGD to 0.05 MGD (n=22) were split evenly (as shown in Figure J-17 above) between their preferences to replace large and small equipment.

Recommendation 1. Increase awareness of Focus on Energy offerings in smaller plant facilities. While smaller plants have less awareness of Focus on Energy offerings, their concerns about energy usage are comparable to larger facilities. Increasing awareness of the value in selecting right-sized equipment for operation from startup through design conditions and providing right-sized tools for operation could allow the facility to grow but be energy efficient in the growth process.

Outcome 3: Plants sized 0.25 MGD to 1 MGD as well as >1 MGD have the highest saturation of listed CMAR WWTP technologies as well as the highest general interest in, and likelihood to install, new equipment. However, mean ratings for adding VSDs in aeration technology present average and mixed interest in the highly efficient technology in turbo aeration and low interest in bubble diffuser technology. WWTPs want to ensure quality of wastewater treatment above all else.

Outcome 4: Key identified barriers were related to costs. The top two barriers identified by the evaluation team for WWTPs adopting energy-efficient technology were the need to pay off loans for the existing equipment (60%, n=50) and the need for substantial investment to make additional energy-efficient improvements (57%, n=49).

Recommendation 2. Increase education and awareness of the benefits of fine bubble diffuser technology for WWTPs. Interest for installing fine bubble diffusers was low across all plant facilities with the exception of large facilities, which have greater interest in fine bubble diffuser technologies in their aeration blower systems.

Recommendation 3. While this survey provides market insights to a significant sample of WWTPs in Wisconsin, the evaluation team recommends a follow-up analysis with in-depth interviews or focus groups with facility managers and owners to better understand the barriers and motivation to adopt energy-efficient technology.

Appendix K. Survey and Interview Instruments by Offering

This appendix includes the CY 2022 survey instruments and ongoing participant satisfaction survey questions for several offerings in Focus on Energy's residential and nonresidential sectors.

Customer Satisfaction Survey Questions

The administrator fielded online customer satisfaction surveys throughout CY 2022. Table K-1 lists the ratings questions asked in the online and mail satisfaction surveys. All questions were based on a 0 to 10 scale, where 10 indicated the highest satisfaction or likelihood to recommend and 0 indicated the lowest satisfaction or likelihood. Four core ratings questions were asked across the surveys:

- **Overall satisfaction**: "Overall, how satisfied are you with your most recent experience with Focus on Energy?"
- **Staff satisfaction**: "How satisfied are you with the [energy advisor or] Focus on Energy staff member who assisted you with your [project/application/order]?"
- **Trade Ally satisfaction (all surveys except Direct to Customer Solution)**: "How satisfied are you with the contractor(s) that [provided your home/facility/school, university or government building upgrades] or [you worked with on this project]?"
- **Likelihood of recommending Focus on Energy**: "How likely are you to recommend Focus on Energy to others?"

Table K-1. CY 2022 Customer Satisfaction Survey Question Matrix: Ratings

Offering Survey	Offering Overall	Staff	Trade Allies	Recommend Focus on Energy	Other Ratings
Direct to Customer Solution [a]	✓	✓	-	✓	✓
Trade Ally Solutions [b]	✓	✓	✓	✓	✓
Business and Industry Solution	✓	✓	✓	✓	-
Schools and Government Solution	✓	✓	✓	✓	-
New Construction Solution: Nonresidential Prescriptive	✓	✓	✓	✓	✓
New Construction Solution: Energy Design Review	✓	✓	✓	✓	✓

[a] Direct to Customer offerings include Online Marketplace, Farmhouse Kits, Packs, Pop-up Retail, Retail Smart Thermostats, and Rural Retail Events.
[b] Trade Ally Solutions offerings include Heating and Cooling, Insulation and Air Sealing, Residential Home Assessments, Renewable Rewards, and Retail Smart Thermostats.

Table K-2 lists the CY 2022 satisfaction survey questions that were not based on a rating. Four additional questions were asked across surveys:

- **Comments and suggestions**: "Please tell us more about your experience and any suggestions for improvement."
- **Awareness of utility role:** "The Focus on Energy program you participated in is offered in partnership with your local energy utility. Before taking this survey, was this something you were aware of?"

- **Opinion of utility**: "How have these offerings affected your opinion of your utility, if at all?"
- **Opt-out of follow-up contact:** "On occasion, Focus on Energy staff may follow up with some survey respondents to learn more about their experience with the program. Please indicate below if you do not want someone from Focus on Energy to contact you about this survey."

Four additional questions were specific to residential and nonresidential offerings:

- **Awareness sources (nonresidential only)**: "How did you learn about this particular opportunity from Focus on Energy?"
- **Focus on Energy assistance (nonresidential only)**: "Aside from providing project incentive dollars, how can Focus on Energy best support your organization going forward?"
- **Age (residential only)**: "Which of the following categories best represents your age?"
- **Income (residential only)**: "Which category best describes your total household income before taxes?"
- **Number in household (residential only)**: "Counting yourself, how many people live in your household on a full-time basis today? Please include everyone who lives in your home and exclude anyone just visiting or children who may be away at college or in the military**.**"

Table K-2. CY 2022 Customer Satisfaction Survey Question Matrix: Non-Ratings

Offering Survey	Core Questions							
	Comments and Suggestions	Awareness of Utility Role	Opinion of Utility	Nonresidential		Residential		
				Awareness Source	Focus Assistance	Age	Income	Number in Household
Direct to Customer	✓	✓	✓	-	-	✓	✓	✓
Trade Ally Solutions	✓	✓	✓	-	-	✓	✓	✓
Business and Industry Solution	✓	✓	✓	✓	✓	-	-	-
Schools and Government Solution	✓	✓	✓	✓	✓	-	-	-
New Construction Solution: Nonresidential Prescriptive	✓	✓	✓	✓	✓	-	-	-
New Construction Solution: Energy Design Review	✓	✓	✓	-	-	-	-	-

Survey and Interview Instruments

Survey instruments are included at the end of this appendix.

Residential Offerings

- Save to Give Offering – 2022 Participant Survey

Nonresidential Offerings

- Commercial Training Offering – 2022 Participant Survey

CADMUS

Wisconsin Focus on Energy

Save to Give Pilot 2023 Participant Survey

Research Questions	Corresponding Question Numbers
How satisfied are participants with the pilot?	A1-A4
What areas did the pilot deliver a positive participant experience?	A2, A4, B4, B5
What challenges did participants experience?	B1-B3
What are participant-suggested ways to improve the pilot?	B6
Do behavioral energy-saving actions persist after participating in a campaign?	C1
Are participants aware of Focus on Energy and the pilot’s partnership with their energy utility?	D1, D3
How does the pilot affect participants’ opinion of their energy utility?	D2
Does the pilot influence participants’ uptake of Focus on Energy offerings?	E1-E4
Does the pilot influence participants’ uptake of non-rebated energy efficient improvements?	E5-E7

Survey Mode: Online only

Sampling Plan and Target Quota: Contact all Save to Give Pilot participants (enrollees) with email in Mount Horeb and New Richmond communities. Collect as many survey completes as possible.

Estimated Timeline for Fielding: Launch on January 31, 2023. One survey reminder email may be sent, depending on the number of completes. Approximately 14 days in the field.

Variables Used in Survey

- MeterGroup
- Name
- Email
- PremiseAddress
- EnrollDate
- Community = Mount Horeb or New Richmond
- Utility = Mount Horeb Utilities or New Richmond Utilities
- TotalPoints

Red text in brackets [ ] indicates survey programming.

A green asterisk * indicates a question asked in Cadmus’ customer satisfaction surveys and/or CEE’s surveys.

Email Invitation

To: [Email]
From: Cadmus on Behalf of Focus on Energy
Subject: How was the Save to Give Challenge? Tell us for a chance at $100!

Dear [Name],

You are part of a group of residents in [Community] participating in the Save to Give Challenge. Focus on Energy, Wisconsin's statewide energy efficiency and renewable energy program, would like to hear about your experience with the Save to Give Challenge. Your feedback is vital in ensuring Focus on Energy continues to meet the needs of local communities.

Please take 5 minutes to respond to this survey. **For completing the survey, we are offering you a chance to enter a drawing to win a $100 VISA gift card.** Two winners will be randomly selected.

Just click the link below to get started.

[Survey Link]

Your feedback will be kept confidential and only be used for research purposes.

If you have problems with the survey link, please contact the survey coordinator, Masumi Izawa, via email at masumi.izawa@cadmusgroup.com. If you would like to confirm the validity of the research effort, please call Mitch Horrie at the Public Service Commission of Wisconsin at (608) 267-3206.

We hope you will take this opportunity to have your voice heard. Thank you in advance for your time and for sharing your experiences.

Follow the link to opt out of future survey emails:
${l://OptOutLink?d=Click here to unsubscribe}

Survey Start Screen

focus on energy®
Partnering with Wisconsin utilities

Welcome! This survey will take approximately 5 minutes to complete. Your responses will remain confidential and will only be used for research purposes. When you complete the survey, you'll qualify for the drawing for a chance to win a $100 VISA gift card.

A. Satisfaction with Pilot

A1. *Overall, how satisfied are you with your experience with the Save to Give Challenge?
1. 0 – Not at all satisfied
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10 – Extremely satisfied
12. Don't know

A2. Please tell us why you gave that rating for overall satisfaction. [Text Entry]

A3. *How likely would you be to recommend the Save to Give Challenge to others?
1. 0 – Extremely unlikely
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10 – Extremely likely/Already recommended
12. Don't know

A4. How satisfied are you with the following aspects of the Save to Give Challenge?
[Response options: 0 – Not at all satisfied, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 – Extremely satisfied, Don't know] [Randomize A-D]
- A. Variety of energy-saving actions
- B. Email communications
- C. Save to Give webpage
- D. Selection of local nonprofits

B. Participant Experience

B1. Were there times when you did not complete an energy-saving action, though you had intended to?

1. Yes
2. No
3. Don't know

[Ask if B1=1]

B2. What were the reasons for not completing the energy-saving action(s)? Select all that apply. [Allow multiple answers] [Randomize 1-6]

1. My home did not have the equipment or features needed to do the action
2. I already installed/ordered the product that the action was recommending
3. Forgot to or meant to do the action but did not get to it in time
4. Did not want to change my habits
5. Did not want to change the indoor comfort level of my home
6. Action was too difficult to do
7. Other (Please describe) [Text Entry]
8. Don't know [Exclusive Answer]

B3. What other difficulties, if any, did you experience with the Save to Give Challenge? Select all that apply. [Allow multiple answers] [Randomize 1-5]

1. Accessing my account for Save to Give
2. Navigating my Save to Give account
3. Remembering to document actions online
4. Staying motivated to keep doing the actions
5. Getting others in my household to participate
6. Other (Please describe) [Text Entry]
7. None/no difficulties [Exclusive Answer]
8. Don't know [Exclusive Answer]

B4. Below are statements about the Save to Give Challenge. Please indicate how well each statement applies to you. [Response options: Very true, Somewhat true, Not very true, Not at all true, Don't know] [Randomize A-E]

A. My household learned new energy-saving actions thru Save to Give
B. My participation in Save to Give made a difference in the community
C. Save to Give allowed me to do my part to protect the environment
D. Save to Give did not lower my energy utility bills
E. Save to Give took a lot of time and effort to do

B5. Each energy-saving action has points assigned to it based on the level of effort and impact of the action. Point values range from 1 point to 3 points per action. Certain actions are repeatable, and points can be earned for completing these actions in all 15 weeks of the three donation campaigns. The table below shows an example of how many points were assigned to certain actions.

Turn off lights behind you 1 point per week (up to 15 points possible)
Use power strips / unplug unused electronics 1 point per week (up to 15 points possible)
Enable power saver modes on computer / TV 2 points for this one-time action
Order free energy saving kit 2 points for this one-time action
Program thermostat up a few degrees for savings 3 points for this one-time action
Order a smart thermostat from Focus on Energy 3 points for this one-time action

How reasonable are the points assigned to the actions?

1. Very reasonable
2. Somewhat reasonable
3. Not too reasonable
4. Not at all reasonable
5. Don't know

B6. What improvements do you suggest for the Save to Give Challenge? [Text Entry]

C. Behavioral Persistence

C1. Which of the Save to Give actions have become something you now do on a regular basis? Select all that apply. [Allow multiple answers] [Randomize 1-9]

1. Take fast showers
2. Wash laundry on cold
3. Adjust thermostat according to season
4. Turn off unused electronics
5. Use power strips
6. Open windows at night during summer
7. Use fans not AC during summer
8. Turn off lights behind you
9. Enable power savings mode on TVs/computers
10. None of the above [Exclusive Answer]
11. Don't know [Exclusive Answer]

D. Awareness and Opinion of Utility

D1. *The Save to Give Challenge you participated in is offered in partnership with [Utility]. Before taking this survey, was this something you were aware of?

1. Yes
2. No

D2. *How has the Save to Give Challenge affected your opinion of [Utility], if at all?

1. Much less favorable towards my utility
2. Somewhat less favorable
3. Does not affect my opinion either way
4. Somewhat more favorable
5. Much more favorable toward my utility
6. Don't know

D3. Focus on Energy is Wisconsin's statewide energy efficiency and renewable energy program. Before you signed up for the Save to Give Challenge, had you heard about Focus on Energy?

1. Yes
2. No

E. Uplift and Spillover

E1. Have you ever participated in a Focus on Energy program offering where you received a rebate/incentive from Focus on Energy?

1. Yes
2. No
3. Don't know

[Ask if E1=1]

E2. You enrolled in the Save to Give Challenge on [EnrollDate]. Did you participate in the Focus on Energy program offering before or after enrolling in the Save to Give Challenge?

1. Before I enrolled in Save To Give
2. After I enrolled in Save To Give
3. Don't know

[Ask if E2=2]

E3. Which of the following energy-efficient products/upgrades did you receive a Focus on Energy rebate/incentive for? Select all that apply. [Allow multiple answers]

1. LEDs
2. Central air source heat pump

3. Ductless / mini-split heat pump
4. Ground source / geothermal heat pump
5. Central air conditioner
6. Furnace
7. Boiler
8. Water heating equipment
9. Insulation
10. Air sealing
11. Duct sealing
12. Smart or Wi-Fi enabled thermostat
13. Recycled a working refrigerator or freezer
14. Other (Please describe) [Text Entry]
15. Don't know [Exclusive answer]

[Ask if E2=2]

E4. How important was the Save to Give Challenge in your decision to participate in the Focus on Energy program offering?
1. 1 – Not at all important
2. 2
3. 3
4. 4
5. 5 – Very important
6. Don't know

E5. After [EnrollDate], have you purchased or installed any energy-efficient products or upgrades at your home for which you **did not receive** a Focus on Energy rebate/incentive?
1. Yes
2. No [Skip to F1]
3. Don't know [Skip to F1]

[Ask if E5=1]

E6. Which of the following energy-efficient products/upgrades did you install for which you **did not receive** a Focus on Energy rebate/incentive? Select all that apply. [Allow multiple answers]
1. LEDs
2. Central air source heat pump
3. Ductless / mini-split heat pump
4. Ground source / geothermal heat pump
5. Central air conditioner
6. Furnace
7. Boiler
8. Water heating equipment

9. Insulation
10. Air sealing
11. Duct sealing
12. Smart or Wi-Fi enabled thermostat
13. Recycled a working refrigerator or freezer
14. Other (Please describe) [Text Entry]
15. Don't know [Exclusive answer]

[Ask if E5=1]

E7. How important was the Save to Give Challenge in your decision to purchase and install the energy-efficient products/upgrades for which you **did not receive** a Focus on Energy rebate/incentive?
1. 1 – Not at all important
2. 2
3. 3
4. 4
5. 5 – Very important
6. Don't know

F. Gift Card Drawing Entry

F1. Thank you for your time! Before you go, would you like to enter in the drawing for a chance to win a $100 VISA gift card?
1. Yes, I'd like a chance at the $100 VISA gift card
2. No, do not enter me in the drawing

F2. Please fill out your name and address to be entered in the drawing. Your information will only be used to mail you the prize in the event that you win. We will not use your information for marketing. Please complete all the fields below to be entered for the drawing.

First and Last Name:
Street Address:
City:
State:
ZIP Code:

End of Survey Message

Your responses have been submitted. Thank you!
You will be notified in a few weeks if you are one of the lucky winners of the gift card prize.

Wisconsin Focus on Energy – Commercial Training Participant Survey 2022

Researchable Questions		
Key Research Topics	**Areas of Investigation**	**Related Questions**
Introduction and Participation	Confirmation of training experience	C1-C4
Spillover and Attribution	Energy efficient measures and behaviors adopted since participating in the training and program credit	D1-D13
Satisfaction	Satisfaction with the training program	E1-E13
Firmographics	Characteristics of the participant's business	F1-F3
Gift Card	Confirm address and interest in follow up survey	G1-G4

Sample Variables:
[COURSENAME] = Training Course Title
[COURSEDATE] = Training Course Date
[EMPLOYER] = Participant employer (firm)

Programming note: Please make all questions required, as applicable with skip logic.

A. Email Invitation

Subject: Please provide your valuable feedback on Focus on Energy's Training Sessions

Dear [TRADE ALLY NAME]:

On behalf of Wisconsin Focus on Energy, Resource Innovations is conducting an evaluation on the training sessions provided to customers and Trade Allies. These educational trainings were held in 2020-2022 and focused on a variety of equipment and energy-related topics.

Records show that you participated in one or more of these trainings. We would like to ask you some questions to garner valuable feedback about your experience with the training and your subsequent program participation. Your responses are important and will help Focus on Energy improve future performance and satisfaction of our offerings and services.

This online survey will take 5-10 minutes to complete. As a token of our appreciation, you will receive a **$20 digital gift card** for completing this survey! Of note, if you have multiple email addresses, please only complete one survey per person.

Please click on the below link to initiate the survey:
[QUALTRICS SURVEY LINK]

If you experience any issues with accessing the survey from clicking above, please copy and paste the below URL into your internet browser to initiate the survey:
[SURVEY LINK]

If you have any technical issues with the survey, please contact Danielle Kolp, Senior Consultant with Resource Innovations, at focusonenergytraining@resource-innovations.com

If you have any questions about the program or about the legitimacy of this survey, please contact Mitch Horrie, Focus on Energy Performance Manager with the Public Service Commission of Wisconsin, at mitch.horrie@wisconsin.gov.

Thank you for your time!
Resource Innovations

B. Survey Start Screen

focus on energy®
Partnering with Wisconsin utilities

Welcome! The goal of this survey is to learn more about your experience with a webinar training sponsored by Wisconsin Focus on Energy. The training course was held on [COURSEDATE] and focused on the topic of [COURSENAME]. As a token of our appreciation, you will receive a **$20 digital gift card** for completing this survey.

Another goal of this survey is to gauge your eligibility and interest in participating in a subsequent phone interview to further understand energy projects completed after the training. Eligible participants who complete the phone interview will receive an additional **$50 digital gift card.**

C. Introduction

C1. Can you please confirm that you participated in a training course on [COURSEDATE] focusing on [COURSENAME]?

1. Yes
2. Yes, the date is correct but the course name is incorrect
    a. Please specify the correct course name___________
3. Yes, the course name is correct but it was on a different date
    b. Please specify the correct date____________
4. I attended a training, but the name and date are incorrect
5. No, I did not attend a training [ENDS SURVEY]

C2. Was the training course you participated in conducted virtually or in person?

1. Virtually
2. In person

C3. How satisfied were you with the format (I.e., in person or virtual) of the training course?
1. Very satisfied
2. Somewhat satisfied
3. Not too satisfied
4. Very dissatisfied

C4. Can you please confirm that you are currently employed by [EMPLOYER]?
1. Yes
2. No

C5. [IF C2=2] Who are you currently employed by? [RESPONSE BOX]

C6. Which of the following best describes your title?
1. Maintenance Personnel
2. Facility Manager or Facility Engineer
3. Plant Manager or Plant Engineer
4. Operations Manager
5. Environmental or Sustainability Manager
6. Energy Manager/Director
7. Utility Manager
8. Cost Reduction Team Leader
9. Lean Six Sigma Team Manager or member
10. Energy Consultant or Advisor
11. Business Owner or Manager
12. Equipment Sales/Service/Installation
13. Engineering Student
14. Other [RESPONSE BOX]

D. Spillover and Attribution

D1. Since participating in the [COURSENAME] training course, have you installed/upgraded any equipment or completed any energy-saving activities for yourself or for your clients?
1. Yes
2. No, I have not completed any new projects since the training [Skip to E1]
3. I don't know [Skip to E1]

D2. [If D1=1] Were these projects installed in the state of Wisconsin?
1. Yes, all
2. Yes, some
3. No [Skip to E1]
4. I don't know [Skip to E1]

D3. [f D2=1,2] Since participating in the training course, which of the following project/equipment types have you installed/upgraded for yourself or for your clients? [SELECT ALL THAT APPLY] [IF D3=17, NO OTHER OPTION ALLOWED]
1. Building Heating Systems
2. Building Cooling Systems

3. Ventilation Systems
4. Motors and/or VFDs
5. Fans
6. Pumps
7. Process Heating
8. Water Using Equipment
9. Compressed Air
10. Industrial Process
11. Thermostats
12. Interior or Exterior Lighting
13. Lighting controls
14. Insulation/Windows/Doors
15. Other [RESPONSE BOX]
16. Solar PV
17. None [Skip to D5]

D4. [If D3=1-16] We would like to know a little bit more about the largest [D3 response] project you completed. [Repeat for each equipment type chosen in D3]

1. How many [D3 response] were installed? [RESPONSE BOX]
2. [If D3=1-10, 15,16] What is the largest equipment size installed? [RESPONSE BOX]
3. [If D3= 10-14] What is the approximate square footage this equipment serves? [RESPONSE BOX]
4. Did you install this equipment at one site or at multiple sites?
   c. One site
   d. Multiple sites
5. Did you or your client receive a Focus on Energy incentive for this equipment? [ONLY ONE RESPONSE ALLOWED]
   e. Yes
   f. Yes – An incentive was obtained on some, but not all, equipment
   g. No – An incentive was not available/eligible
   h. No – An incentive was available/eligible, but I chose not to obtain it.
   i. Maybe – Someone likely pursued an incentive on this equipment, but I didn’t personally help obtain it
   j. I don’t know

D5. [If D4.5=h] Why did you choose to not obtain the available/eligible incentive? [RESPONSE BOX]

D6. Since participating in the training course, have you or your clients adopted any of the following energy saving behaviors? [SELECT ALL THAT APPLY] [IF D5=7, NO OTHER OPTION ALLOWED]

1. Updated operations and/or made maintenance changes
2. Updated energy management activities
3. Updated heating/cooling setpoints and/or schedules
4. Updated lighting controls setpoints and/or schedules
5. Updated industrial process equipment setpoints and/or schedules
6. Other [RESPONSE BOX]
7. I have not changed any energy-impacting behaviors since the training [SKIP TO D8]

D7. Regarding the [D5 response], did you make this change at one site or multiple sites? [Repeat for each equipment type chosen in D5]

1. One site
2. Multiple sites
3. I don't know

D8. Regarding the [D5 response], do you feel these changes had an overall small or large impact on the energy use of the equipment?

1. Small
2. Large
3. It depended on the site, some small and some large impacts
4. I don't know

D9. Regarding the [D5 response], did you receive a Focus on Energy incentive for these changes? [Repeat for each equipment type chosen in D5]

1. Yes
2. Yes – An incentive was obtained on some, but not all, equipment
3. No – An incentive was not available/eligible
4. No – An incentive was available/eligible, but I chose not to obtain it
5. Maybe – Someone likely pursued an incentive, but I didn't personally help obtain it
6. I don't know

D10. [IF D9=4] Why did you choose to not receive the available/eligible Focus on Energy incentive?

D11. As a result of this training program, do you or your clients plan to complete any energy efficiency projects in Wisconsin in the future?

1. Yes
2. No
3. I don't know

D12. [If D9=1] If so, what type of project(s) are planned?

1. [RESPONSE BOX]

D13. [If D10 answered] When do you plan on completing that project(s)?

0. Within six months
1. Six months to a year in the future
2. One to two years in the future
3. More than two years in the future

D14. [ASK IF D3=1-16] How important was your participation in the Focus on Energy sponsored training program in your decision to implement the [D3 response] you mentioned before? Would you say it was very important, somewhat important, not too important, or not at all important? [Repeat for all chosen in D3]

0. Very Important
1. Somewhat Important
2. Not too Important
3. Not at all Important

D15. [ASK IF D5=1-6] How important was your participation in the Focus on Energy sponsored training program in your decision to implement the [D5 response] you mentioned before? Would you say it was very important, somewhat important, not too important, or not at all important? [Repeat for all chosen in D5]

0. Very Important
1. Somewhat Important
2. Not too Important
3. Not at all Important

E. Satisfaction and Motivation

E1. On a scale of 0-10 where 0 is "not at all satisfied" and 10 is "extremely satisfied", how satisfied are you overall with the [COURSENAME] training you attended?

Not at all satisfied 0	1	2	3	4	5	6	7	8	9	Extremely satisfied 10
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

E2. On a scale of 0-10 where 0 is "not at all likely" and 10 is "extremely likely", how likely are you to recommend the Focus on Energy Training Program to a colleague?

Not at all likely 0	1	2	3	4	5	6	7	8	9	Extremely likely 10
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

E3. What parts of the Focus on Energy Training Program are working well? [SELECT ALL THAT APPLY]

1. Training instructor
   a. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
2. Training technical content
   b. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
3. Understanding of Focus on Energy incentives and/or services
   c. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
4. Likely to apply lessons learned to your projects/business
   d. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
5. Networking with Training participants
   e. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
6. Training length
   f. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
7. Training mode (in person and/or webinar)
   g. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
8. Other [RESPONSE BOX]
   h. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
9. None/Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

E4. What parts of the Focus on Energy Training Program could be improved? [SELECT ALL THAT APPLY]

1. Training instructor
   i. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
2. Training technical content
   j. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
3. Understanding of Focus on Energy incentives and/or services
   k. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
4. Likely to apply lessons learned to your projects/business
   l. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
5. Networking with Training participants
   m. How so? [[IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
6. Training length
   n. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
7. Training mode (in person and/or webinar)
   o. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
8. Other [RESPONSE BOX]
   p. How so? [IF CLICKED ALLOW OPEN-ENDED RESPONSE OPTION]
9. None/Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

E5. What motivated you to participate in the [COURSENAME] training you attended?

1. [RESPONSE BOX]

E6. Did you feel like the [COURSENAME] training was a valuable use of your time?

1. Yes
2. No
3. I don't know

E7. Why do you say that?

1. [RESPONSE BOX]

E8. Do you plan to participate in future Wisconsin Focus on Energy trainings?

1. Yes
2. No
3. I don't know

E9. Why do you say that?

1. [RESPONSE BOX]

E10. Did you receive Continuing Education Credits (CEUs) for the training you attended?

1. Yes
2. No - They were not available for the training I attended
3. No - They were available for the training I attended, but I did not pursue them
4. Other [RESPONSE BOX]

E11. [IF E10=3] Why did you choose to not receive the Continuing Education Credits that were available for the training you attended?

E12. [If E10=1] What CEUs did you obtain?
1. [RESPONSE BOX]

E13. Were Continuing Education Credits a motivator for your participation in the training course in any way?
1. Yes
2. No

E14. Do you have any other feedback you'd like to share about the Focus on Energy Training Program that hasn't already been addressed?
1. [RESPONSE BOX]
2. No

F. Firmographics

F1. What industry/sector is your company in? [SELECT ALL THAT APPLY]
1. Food Service
2. Construction
3. K-12 Schools / Universities / Education
4. Government
5. Health Care
6. Nonprofits / Churches
7. Hotels / Motels
8. Retail
9. Commercial Real Estate/Property Management
10. HVAC
11. Lighting
12. Electrical
13. Building Management/BMS/Controls
14. Industrial/Manufacturing
15. Warehouse/Storage/Distribution
16. Data Centers
17. Solar/Wind/Batteries/EV's
18. Other, please specify: [FORCED TEXT ENTRY RESPONSE]
19. Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

F2. How many locations does your company operate in Wisconsin?
1. Please specify number: [FORCED TEXT ENTRY RESPONSE]
2. Don't know

F3. Does your organization lease or own the facility or facilities you operate in?
1. Lease
2. Own
3. Combination of leasing and ownership
4. Other, please specify: [FORCED TEXT ENTRY RESPONSE]
5. Don't know

G. Gift Card

G1. [ASK ALL] Thank you. We appreciate your help with this survey. Those are all the questions we have for you. Please provide your name and email address to receive your $20 digital gift card. We will deliver the gift card to your email address in 2 to 4 weeks.

1. First and Last Name: [RESPONSE BOX]
2. Email address: [RESPONSE BOX]
3. I am not interested in receiving a gift card

G2. [If D3=1-16 and/or D5=1-6] We will be conducting a series of follow-up phone interviews among participants who have completed eligible projects since participating in the training course. The purpose being to further understand the installed equipment. Participants who have completed eligible projects and complete the phone interview will receive an additional $50 digital gift card. Are you interested in being considered for the phone interview?

1. Yes
2. No

G3. [If G2=1] What are your preferred email address and phone number for the phone interview?

1. Email address: [RESPONSE BOX]
2. Phone number: [RESPONSE BOX]

G4. [If G2=1] What are your preferred contact days and times (AM vs PM)? This will aid in scheduling the phone interview. [SELECT ALL THAT APPLY]

1. Monday AM
2. Monday PM
3. Tuesday AM
4. Tuesday PM
5. Wednesday AM
6. Wednesday PM
7. Thursday AM
8. Thursday PM
9. Friday AM
10. Friday PM

[IF C1 = NO]
[THANK AND TERMINATE]
Thank you for your time today. Unfortunately, you are not eligible to complete this survey because the questions are about a training session you did not attend. Please email matthew.wisnefske@cadmusgroup.com if you believe you have arrived at this message in error.

[END OF SURVEY MESSAGE]
Success! Your responses have been submitted. Thank you for your time today.
For more information on Focus on Energy's offerings and services, check out www.focusonenergy.com [PROVIDE LINK TO FOCUS ON ENERGY WEBSITE]